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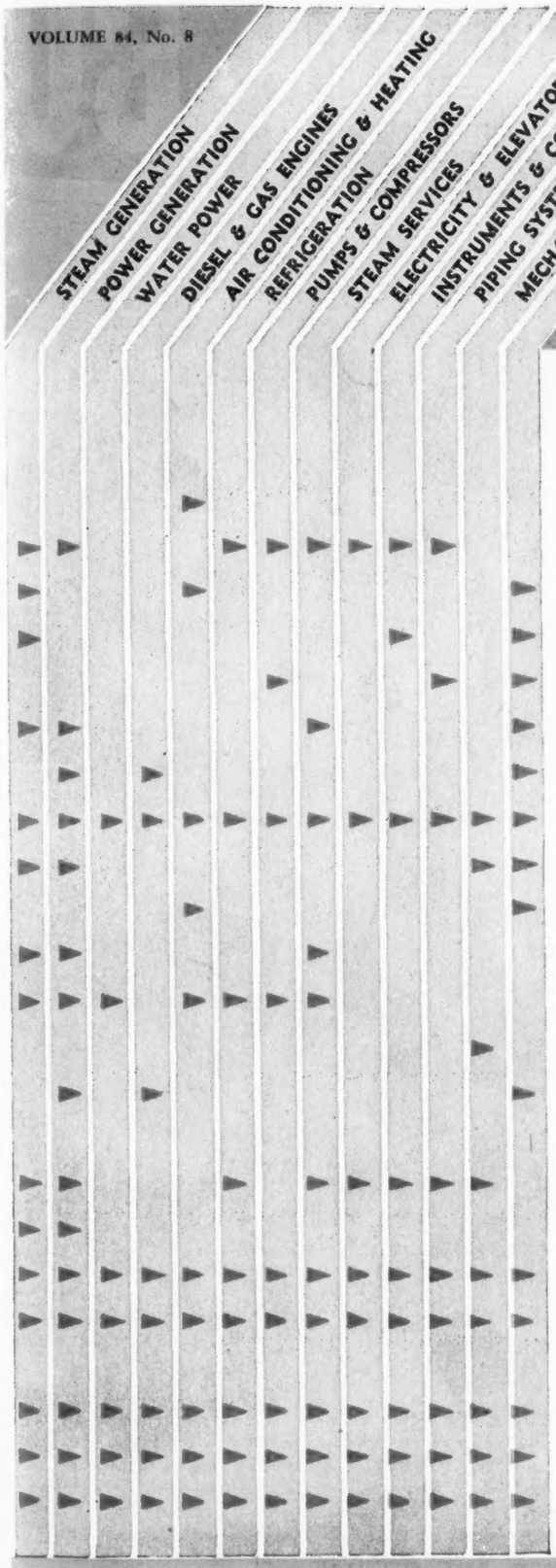

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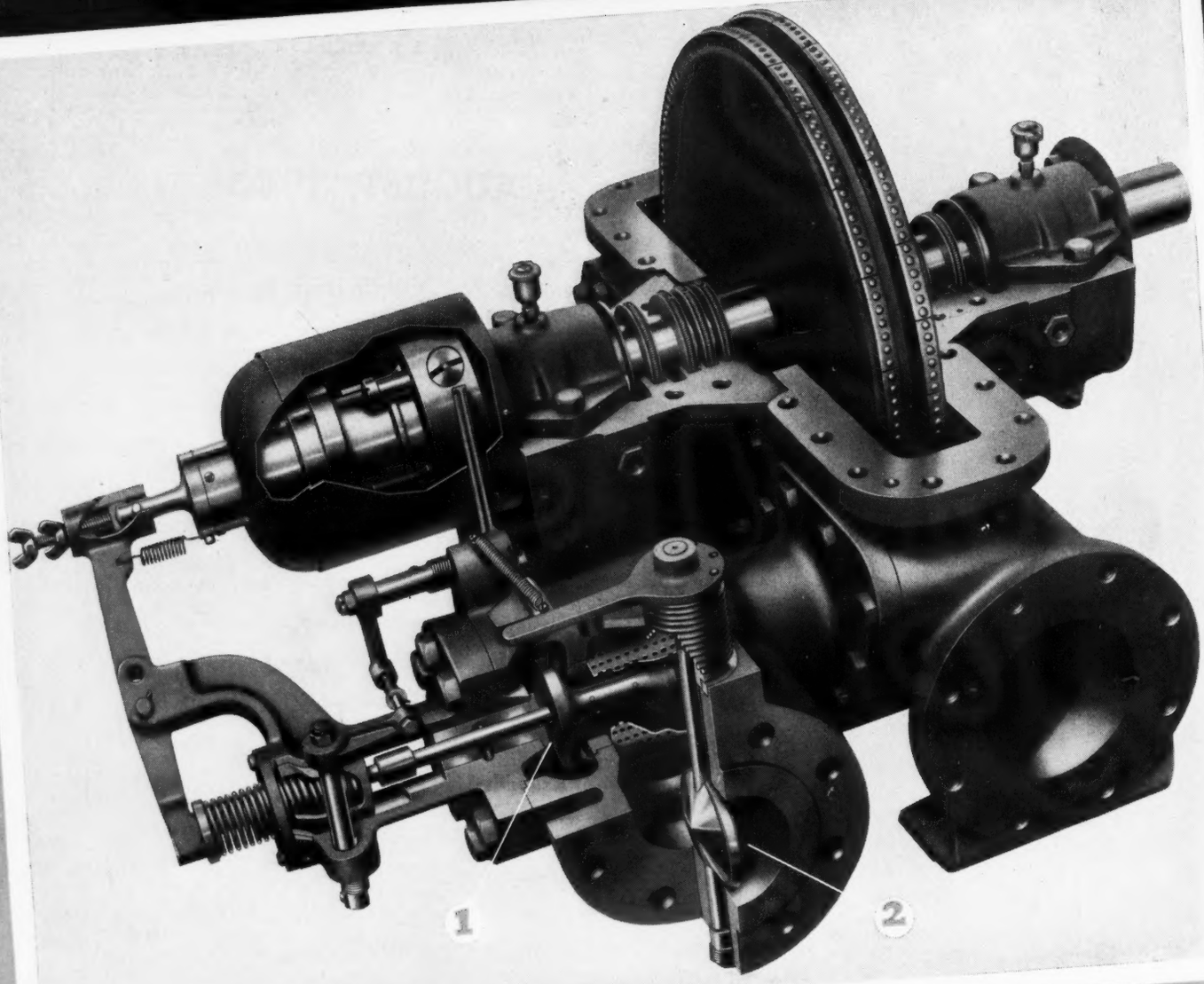

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Power for Defense

With a huge defense program gaining momentum, power engineers everywhere must consider the part they may be called upon to play. Here is a cold-blooded summary of the industrial power prospects:

First, let's consider power in the narrow sense as electricity only. Considerably more than half of the electrical energy consumed by industry at large comes from the central stations. All of the utilities have carefully studied conditions in their supply areas. As far as we can ascertain, all feel that they have ample generating capacity to meet any probable requirements of their industrial customers as now equipped. All feel that they can expand generating capacity fast enough to take care of any likely expansion of manufacturing capacity.

Meanwhile the utility industry is taking no chances. It will increase its generating capacity 1,600,000 kw this year and plans to add another million and a quarter kw in 1941. Already manufacturers of large turbines are booked with orders to keep them busy until September, 1941.

But central-power supply is only half the picture; how about the industrial power plant?

Although considerably less than half of the electrical energy used by industry is generated at the point of use, it so happens that this locally generated electricity is largely concentrated in key defense industrials—notably in chemical factories, automotive plants, steel mills—establishments characterized either by large size, or by a heavy process-heat load, or both. Thus the industrial generating plant is far more important in the defense-power picture than is generally realized even by the special governmental and private groups that have been studying the problem of industrial power supply from the angle of national defense.

The persistent tendency, even of the "experts," to think of industrial power exclusively in terms of central electrical supply is a strange and dangerous phenomenon. Every industrial power engineer can perform a patriotic service by reiterating, on every suitable occasion, this thought, "don't forget the industrial power plant and the essential part it must play in America's defense program."

To this warning he may well add "and don't forget process steam." Whether it makes its own electricity or buys it from an inexhaustible source, the process industrial must shut down if steam fails.

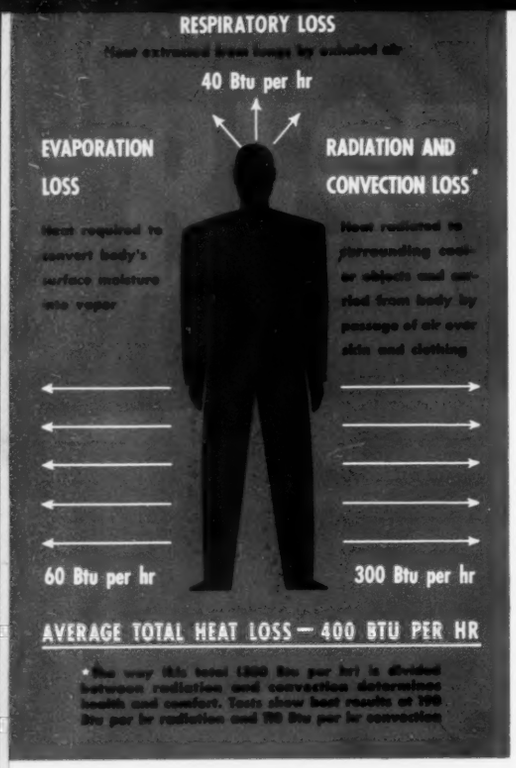
How about industrial boiler capacity, then? Is there cause for alarm? We don't say the condition is alarming, but would describe it as slightly nervous and worth watching. The power plant that can operate the present factory full tilt with one of the larger boilers always in reserve can get by until the manufacturing equipment is expanded, even though the plant should go to two- or three-shift operation seven days a week. The fellow who *isn't* safe is the engineer who has been counting on low-load periods, nights or weekends, to clean boilers and repair furnaces. He can't continue to depend on these slack periods. He must install a spare boiler to avoid a possible critical situation.

How about factory expansion? If there is any chance of such expansion to meet defense demands the power engineer should immediately check with the manufacturers of boilers and steam-generating auxiliaries to make sure that he could increase his steam-generating capacity at least as fast as the factory could increase its steam-using capacity—and, if not, start getting ready ahead of time.

In short, the whole line of power-service equipment should be checked—service by service, piece by piece and at once—to make sure that no bottle neck will clog production at a time when correction may be made doubly difficult by slow deliveries on all kinds of heavy equipment.

And don't forget that dependable power-plant capacity involves men as well as equipment. Is your staff versatile? Could you carry on if one or several of your key operators were suddenly called to military service?

These are some of the things to think about. Forehanded thinking right now is the best service any power engineer can give his country.


RESPIRATORY LOSS
40 Btu per hr
EVAPORATION LOSS
RADIATION AND CONVECTION LOSS*
60 Btu per hr
300 Btu per hr
AVERAGE TOTAL HEAT LOSS — 400 BTU PER HR

What's Ahead for Panel

By L N ROWLEY
Associate Editor

Claimed to produce more comfortable and healthful conditions, to save building space, and to reduce fuel consumption, "panel" heating comes to the fore in this country after long acceptance in England. Here is a condensed report to power engineers, answering the questions: How does it work? How is it installed? What is its future?

▶ PANEL HEATING ISN'T NEW. We see its principles in action every time we watch newsreel shots of bathing beauties romping in apparent comfort on some sunlit but definitely snow-covered mountainside. The ancient Romans warmed their villas with a crude version of panel heating, more because it fitted the building construction of those days than because of any real appreciaton of its merits. Modern radiant heating goes back to 1907, when A H Barker, an Englishman, heated a building by means of wall panels warmed by hot-water flowing in embedded pipes.

Barker claimed three major advantages for this system of heating: (1) more comfortable and healthful conditions, (2) space-saving, inconspicuous heating surfaces, and (3) lower fuel consumption.

How It Works

To get a clear picture of the way panel or radiant heating achieves these advantages means dumping overboard most of our present way of thinking about heating and heating systems.

Most heating systems with which we are familiar aim at maintaining the air in a room or building at some temperature deemed desirable for human comfort. This may be accomplished by various means, such as raising the air-stream temperature in a central unit and circulating the warmed air to the rooms, or by warming the air in individual spaces by local heating units. In any case, the emphasis is on "heating the building."

Panel heating tackles the job from an entirely different point of view; it starts with the human heat balance and aims to create conditions that will maintain the best balance from the standpoint of comfort and health. Thus, to get a clear idea of what panel heating is and does we need to look first at the human body and the mechanism by which it adjusts itself to its surroundings.

Contrary to what might seem obvious, there is no need to *supply* heat to the body—this complex heat engine converts chemical energy of foodstuffs into physical activity and, like all heat engines familiar to engineers, must dispose of some surplus heat. Experiments show that the average human throws off approximately 400 Btu each hour, the exact amount depending on the person, on the rate of activity, and on surrounding conditions.

This surplus heat leaves the body by four paths (Fig. 1): The major part, about 300 Btu per hr under average conditions, leaves the skin and clothing by radiation and convection. A much smaller amount, about 60 Btu, goes to evaporate surface moisture, and a still smaller quantity, about 40 Btu, leaves the body in the air exhaled from the lungs and in body wastes.

Various factors alter the proportion of heat flowing out by these paths, although the last item, 40 Btu, remains fairly constant. We all know how changes in the evaporation rate adjust body conditions, but probably don't think of it in "scientific" terms. Thus, in summer, when high surrounding temperatures cut down the possible loss by radiation and convection, we perspire freely and the heat used in evaporating the moisture restores the balance and holds the body temperature down.

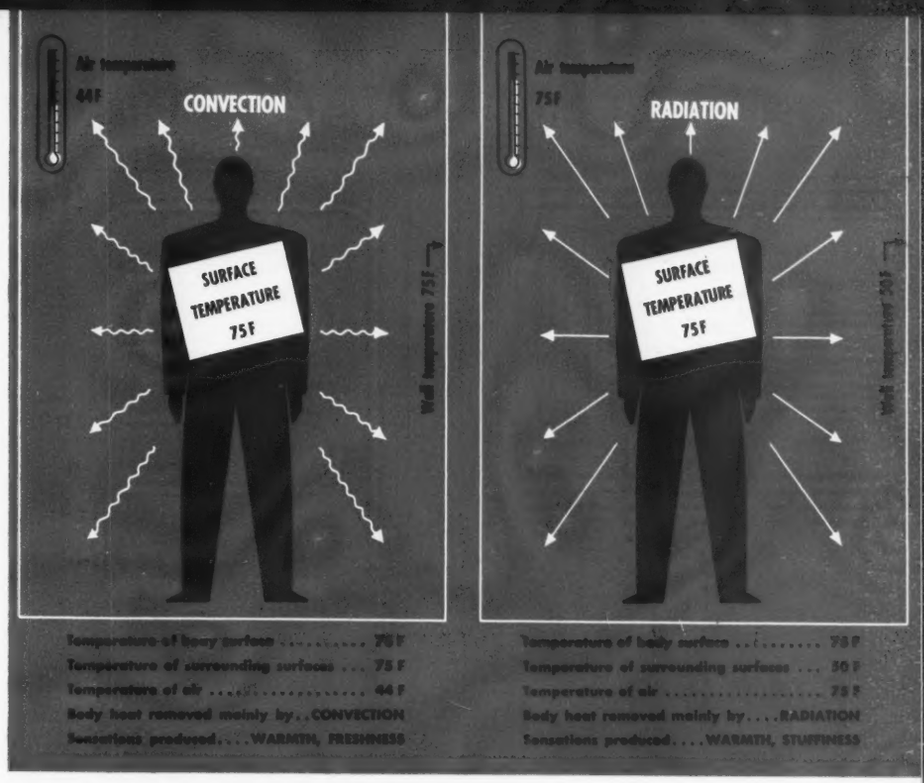
The heat loss by radiation and convection is by far the largest under normal conditions, and it thus rates first consideration in the problem of heating. Experiments indicate that when about 190 Btu per hr of the total flows out by radiation and 110 Btu by convection, maximum comfort and healthfulness result. Before considering how this ideal balance can be maintained, let's review briefly those two important ways of transferring heat—radiation and convection—since everything depends on a firm grasp of these principles.

Step from the sunshine into the shade of a tree. You *feel* cooler but the air temperature hasn't changed. Why? Energy flows from the sun by radiation in the form of waves similar in many ways to light waves, differing primarily in wavelength. Solid objects absorb this radiant energy and convert it into heat —thus we are warmer in the sunshine than in the shade even though the surrounding air stays at the same temperature, not being measurably affected by the energy waves passing through it.

We know these things about radiant energy: it always flows from a hot body to a cold body, it flows in a straight line unaffected by air currents, it can be focussed, absorbed, or reflected exactly as light rays. The intensity of thermal radiation depends on the temperature of the source (proportional to the 4th power of the absolute temperature) and on the color, nature and surface condition of the source. Finally, the amount of heat absorbed by a body in the path of radiant energy depends on the color, nature and surface condition of the body (A black body absorbs radiation readily; a polished metallic surface reflects radiation and so can be used as an insulator).

So much for radiation. Convection, we know, involves heat transfer by

Heating?


Air temperature
44 F
CONVECTION
SURFACE TEMPERATURE 75 F
Wall temperature 75 F
Temperature of body surface ..... 75 F
Temperature of surrounding surfaces ... 75 F
Temperature of air ..... 44 F
Body heat removed mainly by..CONVECTION
Sensations produced....WARMTH, FRESHNESS
Air temperature
75 F
RADIATION
SURFACE TEMPERATURE 75 F
Wall temperature 50 F
Temperature of body surface ..... 75 F
Temperature of surrounding surfaces ... 50 F
Temperature of air ..... 75 F
Body heat removed mainly by....RADIATION
Sensations produced....WARMTH, STUFFINESS

means of air currents. A body at higher temperature gives heat by conduction to the surrounding air which is set in motion due to the temperature difference. The air stream, in turn, gives up heat by conduction to bodies at a lower temperature.

We have seen that the body loses heat both by radiation and conduction, and that certain proportions should be maintained for maximum comfort and health. To see more clearly what this means, consider Fig. 2, based on hypothetical examples cited by A H Barker.

Assuming that the average surface temperature is 75 F, a person standing in a room with its air heated to the same temperature could lose no heat by convection, since the necessary temperature difference does not exist. To lose all the normal 300 Btu per hr by radiation alone, would mean that surrounding solid surfaces (walls, floor, ceiling) would have to be at about 50 F.

Better Balance

Now if the surrounding surfaces were at 75 F, the same temperature as the body surface, there could be no flow of radiant energy from hot body to cold body, and convection would have to do the entire job. This means an air temperature of about 44 F.

In both cases, there is a sensation of warmth. However, in the first case there would be an accompanying sensation of *stuffiness*, while in the second case the feeling would be of *freshness*. The proponents of panel heating say that in the average heating system, with room air above 70 F, conditions more nearly resemble the first case, and the body loses more than the desirable amount of heat by radiation to the surrounding solid surfaces.

The panel-heating engineer tries to bring about a better balance between radiation and convection heat loss from the body by maintaining large room areas (floors, walls or ceilings) at a sufficiently high temperature to restrict radiation from the body to a desirable amount and to give comfort without needlessly heating the air. To do this, various types of heating surface are embedded in room surfaces to raise their temperature. This was first attempted by means of panels, and so the term "panel heating" came to describe what is properly known as "radiant heating."

Now, while all heating systems aim at effecting comfort by controlling bodily heat loss, for conventional systems the practical goal is maintenance of a desired air temperature inside a space or building, so that to calculate the heating effect needed the designer considers the heat loss from the walls of the space and supplies enough heat to hold the desired air temperature. Since we have seen that radiant heating aims directly at regulating the rate and manner of heat loss from the body, it is apparent that the method of calculation must be different. Briefly, this involves ascertaining the desired mean radiant temperature of room surfaces, deciding at what temperature the heating surface shall operate, computing the size and disposition of the heating surfaces required to produce the mean radiant temperature, and finally providing convected heat for the required number of air changes. The method is explained in detail in the ASHVE Guide (1940).

What are the advantages of radiant heating beyond these resulting from producing conditions claimed to be more nearly theoretically perfect? Associated advantages come from higher floor temperatures and better temperature distribution from floor to ceiling; from a reduction in convection currents, which means an absence of drafts and less dust movement; and from a decreased contrast between indoor and outdoor temperatures.

To practical engineers these advantages loom large: heating elements take practically no useful space and do not interfere with or mar decorations; building alterations may be easily made if heating coils are in floor or ceiling; and radiant heating solves difficult heating problems associated with frequently used entrances, high ceilings, and large glass areas. Finally, some proponents of radiant heating claim that it is more economical because lower inside air temperatures are maintained and heat loss through outside walls is reduced.

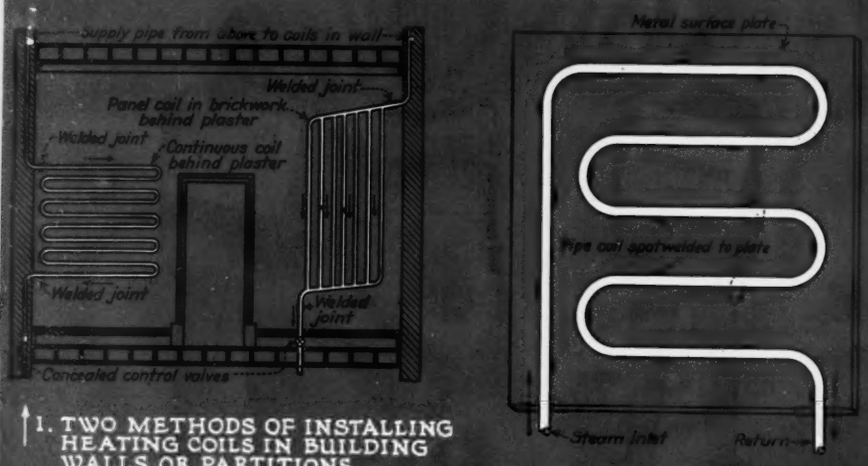
Problems

On the other hand, radiant heating presents many engineering and construction problems. Perhaps most important, the successful operation of any embedded system throws a heavy responsibility on the materials used and the method of construction. Piping and heating elements must resist corrosion, steam systems and installations using well water for cooling, must be protected by water treatment to prevent corrosion, scaling, and deposits, and construction must be such as to avoid fracture from unequal expansion or plaster cracking from excessive heat. A failure of an embedded system involves, of necessity, heavy expense for repairs. However, there seems no reason why careful selection of materials and sound engineering cannot overcome these obstacles and successful existing installations of radiant heating indicate this is true.

How, actually, is radiant heating applied? These are basic arrangements (see illustration on following page):

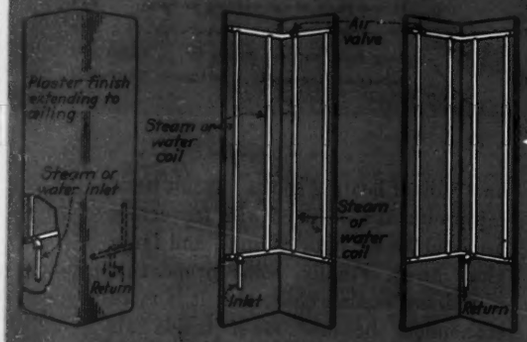
1. *Pipe coils embedded in concrete or plaster of walls or ceilings.* Small pipe, fairly closely spaced, heats entire surface; low temperature to prevent plaster cracking favors hot water as medium, operating on a vented forced-circula-

RADIANT HEATING
TYPICAL METHODS OF INSTALLATION



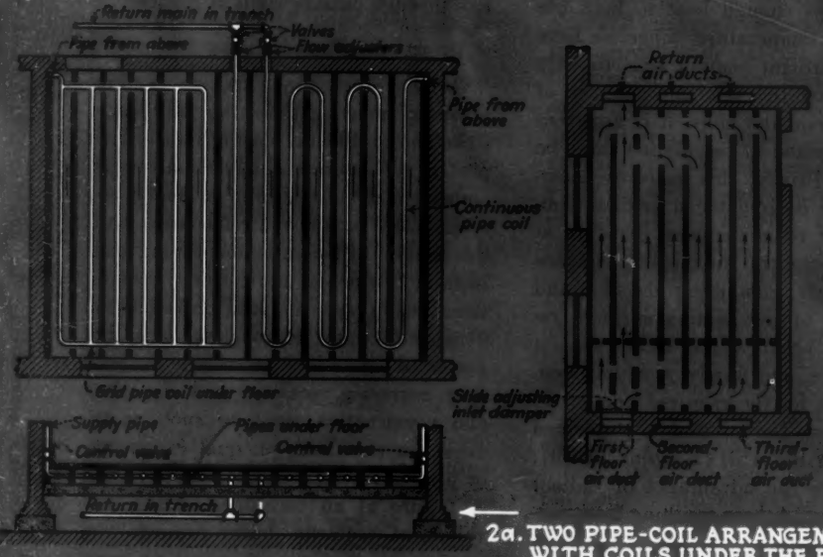
1. TWO METHODS OF INSTALLING HEATING COILS IN BUILDING WALLS OR PARTITIONS

4. HEATED METAL PANELS CAN BE INSTALLED IN AN INSULATED RECESS OR ON THE WALL SURFACE

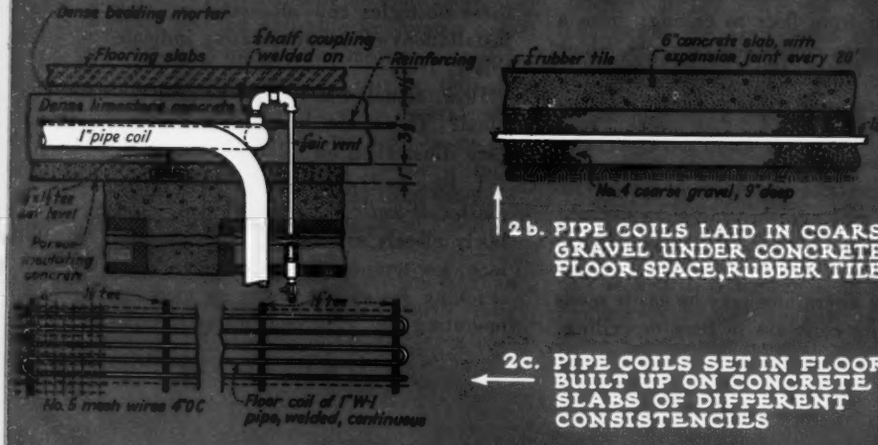


1a. PIPE COILS IN BUILDING COLUMNS MAY BE USED IN DEPARTMENT STORES, ETC

3. TO HEAT FLOOR WITH WARM AIR, SPACE BETWEEN SUPPORTS MAY BE USED OR DUCTS MAY BE INSTALLED



2a. TWO PIPE-COIL ARRANGEMENTS WITH COILS UNDER THE FLOOR BETWEEN STRUCTURAL MEMBERS


Dense bedding mortar
Flooring slabs
½ half coupling welded on
Reinforcing
Dense limeconcrete
1" pipe coil
Air vent
Porous insulating concrete
No. 5 mesh wires 4" O.C.
Floor coil of 1" W.I. pipe, welded, continuous
½" rubber tile
6" concrete slab, with expansion joint every 20'
No. 4 coarse gravel, 9" deep

2b. PIPE COILS LAID IN COARSE GRAVEL UNDER CONCRETE FLOOR SPACE, RUBBER TILED

2c. PIPE COILS SET IN FLOOR BUILT UP ON CONCRETE SLABS OF DIFFERENT CONSISTENCIES

tion system. Properly designed, this system gives comfortable results and good economy but lacks flexibility when building alterations are necessary.

2. *Pipe coils under or in the floor.* Pipe coils for steam or hot water may be (a) installed between the structural members under the floor, which may be of wood blocks, concrete, marble or any other material unaffected by heat, (b) embedded directly in concrete, or (c) laid in gravel under the concrete slab.

3. *Air circulated under floor.* Air in ducts or circulating between floor supports heats entire surface; to insure uniform temperature, even distribution must be secured.

4. *Separate heated plates or panels.* Installed in insulated recess or on wall surface, metal panels can be heated by steam, hot water or electricity. They may be covered for decorative purposes; low surface temperatures give better comfort and are more efficient. Electrically heated tapestries or rugs, with continuous conductor woven into the fabric, offer a flexible means of radiant heating existing spaces.

Air Conditioning

In a complete job, air conditioning and panel heating work side by side. There is still need for ventilation, for an adequate supply of clean air of proper temperature and humidity. The major difference is that a great part of the heating burden has been removed so that the principal work for the conditioning unit becomes filtering and humidifying, with only enough heating to bring air to the rooms at a reasonable temperature.

In hot weather, without air conditioning, body heat loss by convection almost disappears due to high air temperatures, and higher temperatures of surrounding surfaces cut down radiation loss so that we observe the common summer experience of heavy perspiration which takes care of the situation by increasing the evaporation loss. Conventional air conditioning cools by increasing the body's convection loss. By circulating cold well water or chilled water through radiant surfaces, they can be made to cool by increasing the body's radiation loss.

The combination of comfort and health gains plus definite practical and architectural advantages makes panel heating worth consideration for office buildings, hospitals, hotels, and similar large structures, and the reduction of convection difficulties seems to make it particularly attractive for factories and industrial buildings. In a new building, a properly engineered system should not increase the total cost of the structure.

Modern Power for Modern Refinery

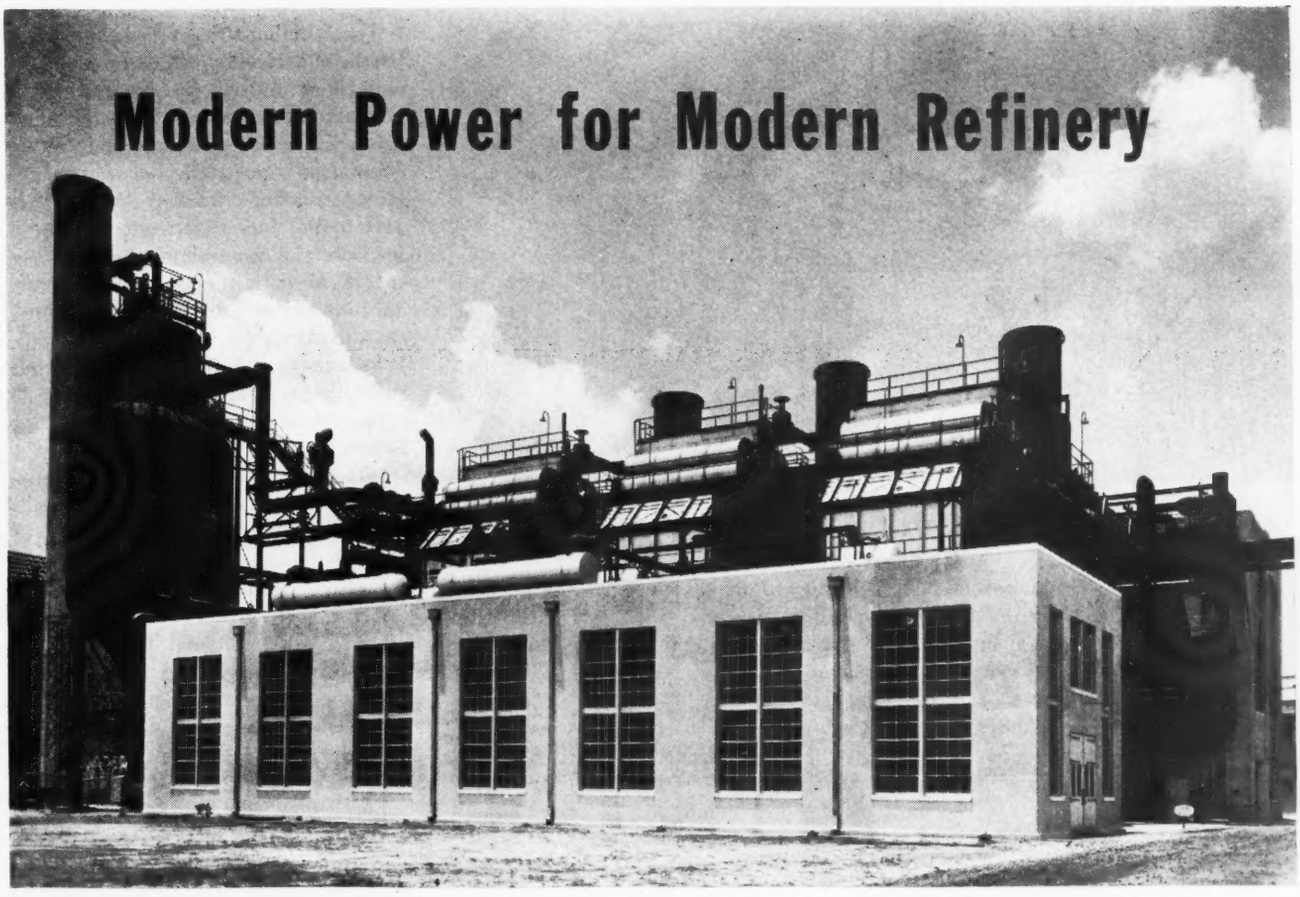


Fig. 1—One-story structure in front of boilers houses firing aisle, feed and fuel pumps, and boiler controls

Outdoor boiler plant serves backpressure and mixed-pressure turbines in 22,500-kw extension to power facilities of The Texas Co's Port Arthur refinery. Design aimed at greater flexibility and availability

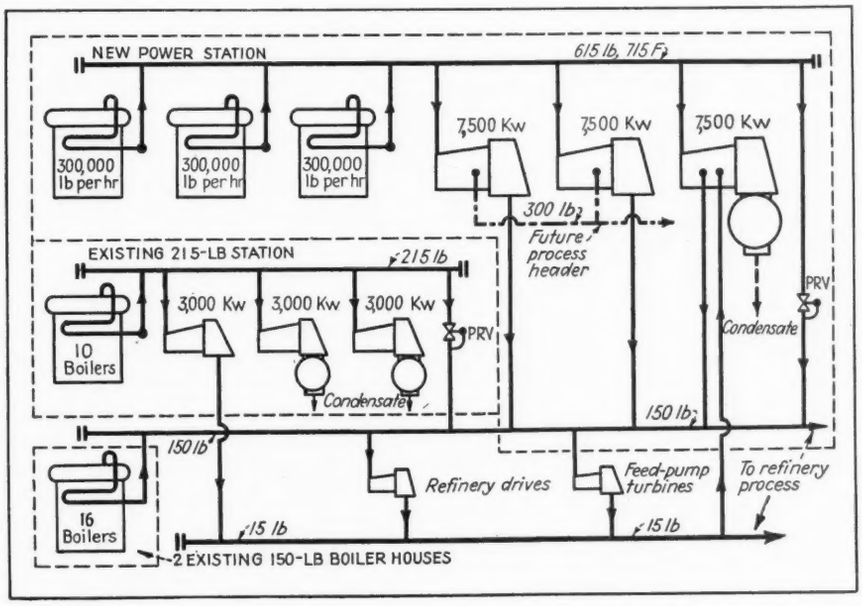


Fig. 2—Flow diagram shows how new extension ties in with existing facilities

► AN OUTDOOR BOILER PLANT and new backpressure and mixed-pressure turbine generators now meet increased steam and power loads at the Port Arthur, Texas, refinery of The Texas Co. This modern plant represents the most economical solution to the problem presented by extended refining facilities and changes in refining processes which radically altered the former steam and power balance.

Existing facilities included two 150-lb boiler houses with a total of 16 boilers (98,480 sq ft), a 215-lb plant housing ten boilers (74,440 sq ft) and three 3000-kw turbine-generators, one operating at 15-lb back-pressure and the others condensing (see Fig. 2). This plant went into service in 1923, and has seen some additions and changes since that time. By 1938 these generating facilities were taxed to capacity. Steam loads averaged around 1,200,000 lb per hr and were growing rapidly, while some of the equipment was reaching the replacement stage. Electrical loads averaged around 15,000 kw, with peaks much higher, and a large portion of the current used had to be bought from the local utility.

Conditions pointed to installation of high-pressure boilers and turbines ex-

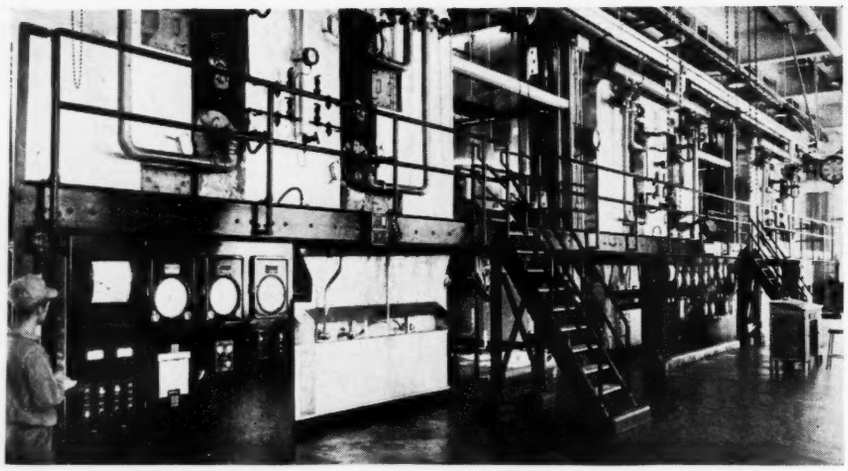


Fig. 3—Boiler firing aisle showing combination burners and boiler controls

hausting to process-steam headers. A careful study of the entire situation showed that designing for about 600 lb initial pressure and 150 lb backpressure offered the greatest economy and adequate flexibility for future development. Figs. 2 and 5 show how the new equipment ties in with existing facilities.

The three new boilers are 3-drum units (Fig. 4)) with steam washers. Each will deliver 300,000 lb per hr (615 lb and 715 F), when supplied with 340-F feedwater. Because Gulf-coast temperatures are moderate and outdoor construction is common for refinery equipment, boilers and accessory equipment were designed for outside operation; a 1-story building houses the firing aisle, feed pumps, fuel-oil pumps, and boiler instruments and controls.

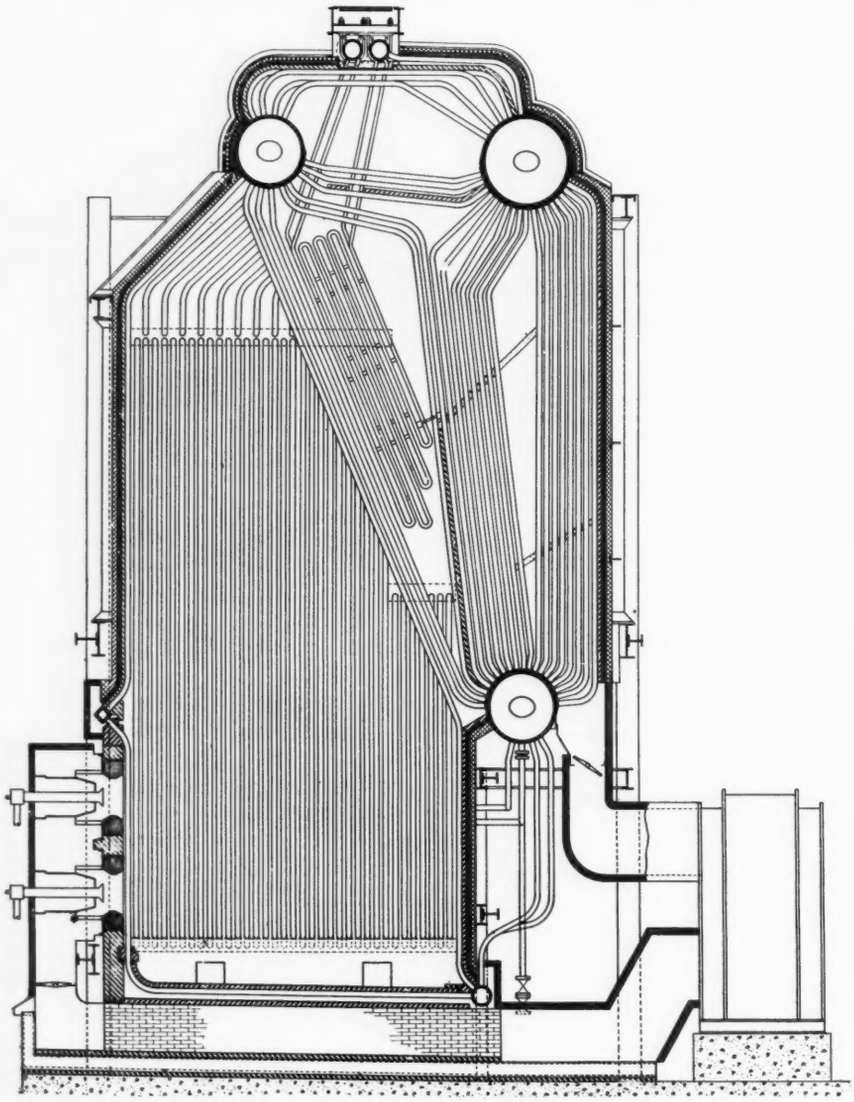


Fig. 4—Cross-section of one of the three 300,000-lb-per-hr, 3-drum boilers

The four burners on each boiler can handle either 1600-Btu refinery gas (the main fuel), or 1000-Btu natural gas, or any mixture of the two. Oil is the emergency fuel; full handling and burner equipment is provided. Because pulverized petroleum coke may later supply part of the fuel requirements, burner, furnace, and general plant design are such as to permit conversion. Furnaces are fully water-cooled. A bypass damper controls superheat.

Because ample low-level heat was available for heating feedwater, and to keep maintenance costs to a minimum, designers selected air heaters in preference to economizers. Two fan sets supply each boiler; each set includes a 187,500-cfm forced-draft fan and a 205,000-cfm induced-draft fan, mounted on a single shaft driven by a 400-hp motor. One such set will carry the boiler up to 70% of maximum. Choice of constant-speed motors and vane control gave low first cost and fitted base-load nature of refinery steam demand.

Feedwater Treatment

Fig. 7 shows the feedwater treatment system. Existing facilities included a cold-water plant where Neches River water was treated with alum, coagulated and settled, sand-filtered, and zeolite-softened. The result was practically zero hardness, and a sulfate-carbonate ratio of about 1:1. To fit this plant to supply the new boilers, requiring a 3:1 sulfate-carbonate ratio, a rubber-lined acid mixer and inlet line supply sulfuric acid at the inlet of a new deaerating heater, operating at 15-lb steam pressure. This arrangement drives off CO_2, reduces alkalinity, and produces the desired ratio without materially changing the solid-content of the water.

A layer of 18–8 stainless steel in the upper portion of the deaerator protects against corrosion. If needed, caustic soda and sodium sulphite, introduced at the deaerator outlet, will control alkalinity and eliminate all hazard of oxygen corrosion. Phosphate is added to each boiler in the steam drum, below the steam washer.

Immediately below the deaerator, a 700,000-lb cone-bottom storage tank, with full provision for possible later use as a hot-process sedimentation tank, holds hot treated water and condensate. Water flows from this tank to three 5-stage, 1130-gpm feed pumps (one a spare) which supply the two high-pressure heaters. Feedwater leaves these heaters, for the boiler, at 340 F. A 700-hp motor drives one pump; a 700-hp turbine drives another; the third has dual drive. In normal operation, the motors handle the job but in event of

motor failure, or power shortage, the turbines automatically pick up the load.

Backpressure turbines (Fig. 6) exhausting at 150 lb and with provision for future extraction at 300 lb, drive two of the three new 7500-kw, 0.8-pf, 2400-volt, 60-cycle, 3-phase, 3600-rpm generators, with direct-connected exciters. A mixed-pressure condensing machine, with extraction at 150 lb and induction at 15 lb, drives the third generator. This unit, by its ability to absorb up to 125,000 lb per hr of 15-lb steam, takes care of a surplus of low-pressure steam that could only have been eliminated by extensive motorization of refinery drives, involving a large investment. The flexibility of the mixed-pressure design will meet any future changes, resulting from comprehensive motorization, without loss of efficiency or capacity.

Combustion Control

To provide for use of steaming capacity of the high-pressure boilers in excess of turbine-generator requirements, a 350,000-lb-per-hr reducing-valve and desuperheater station operates as a spillover, controlling pressure in the 600-lb main by relieving steam not required by the turbines. This simplifies combustion-control problems, eliminating need for tying combustion to steam pressure. Operators regulate fuel feed by hand; automatic regulators adjust the forced- and induced-draft fan controls and the dampers to insure a constant air-fuel ratio. This arrangement fits plant conditions nicely, with the new boilers operating in parallel with existing low-pressure boilers, through the turbines and reducing station. Best over-all efficiency results from carrying a maximum base load on the new units and taking swings in the refinery's demand for 150-lb steam on the old boilers.

Design of the plant as a whole aims at greatest possible flexibility and availability. Locating air heaters, forced- and induced-draft fans and drives, feed and fuel pumps, booster pumps, and blowdown controls at ground level gives ease of operation and control and simplifies maintenance work. Similar advantages accrue from making control of equipment and motor-operated valves available to the operator at the best vantage points. Providing duplicate equipment or steam-driven spares for auxiliaries contributes to reliability, as do parallel buses in main switchgear, 2300-volt auxiliary gear, and in 220- and 110-volt equipment.

The plant was designed by the engineering organization of The Texas Co and Jackson and Moreland, consulting engineers of Boston.

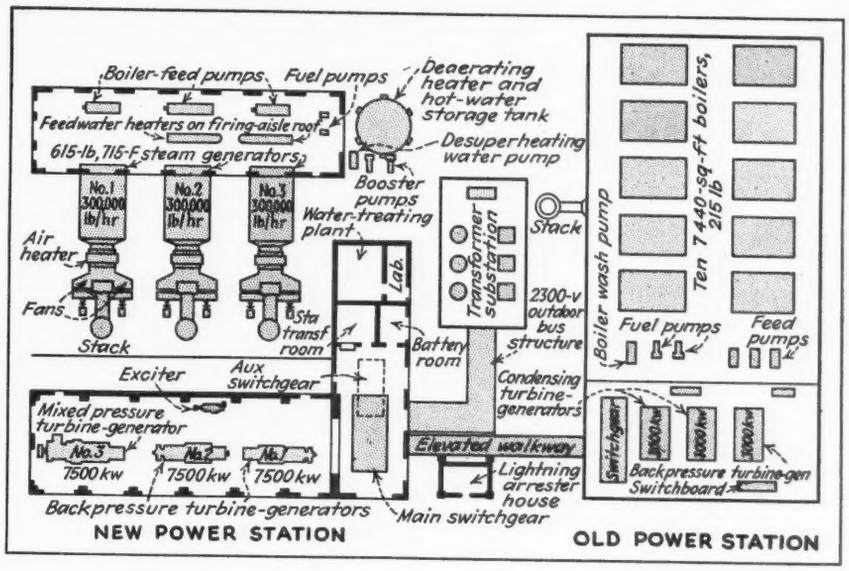


Fig. 5—Plan layout of new and old power stations

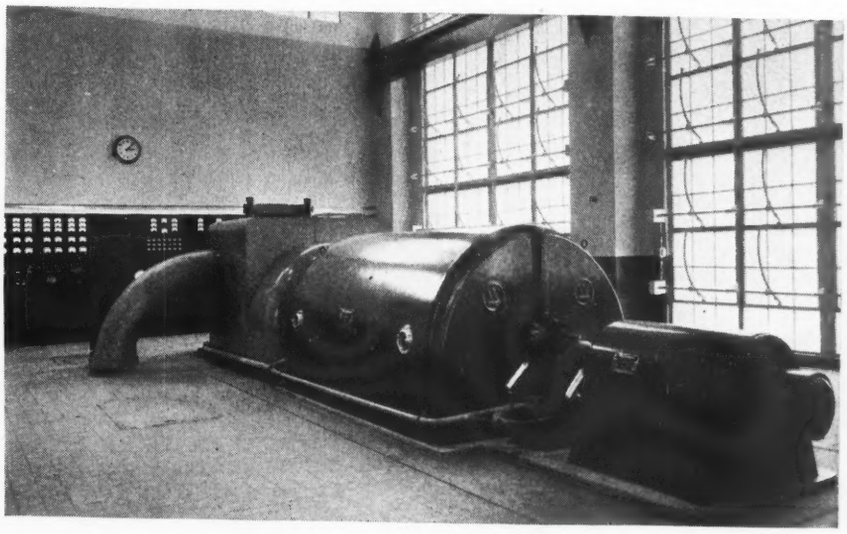


Fig. 6—One of the two 7500-kw extraction-backpressure turbines

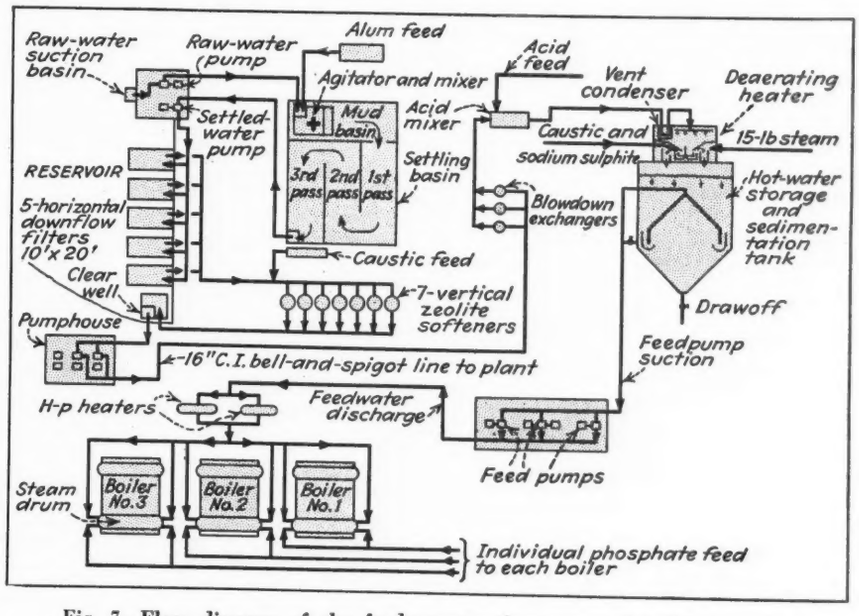


Fig. 7—Flow diagram of the feedwater-treating system for the extension

Treating Boiler Feedwater at Federal

The complete feedwater story of America's second largest heating plant — methods, equipment and costs

By CHARLES B OVERMAN
Associate Engineer (Chemical), Office of Buildings Manager
Public Buildings Administration, Federal Works Agency

▶ IN THE PAST TWENTY YEARS rapid strides have been made in the mechanical development of boiler plants generating steam both for power and heating requirements. Boiler pressures and evaporation rates have increased progressively year by year—present-day units evaporate more than 1,000,000 lb of water an hour per boiler at pressures exceeding 1300 lb per sq in. In 1918, a single unit evaporating 150,000 lb per hr at 375 lb per sq in. represented an outstanding achievement in boiler design.

Making this progress possible, or, depending on the point of view, necessitated by it, has been the coincident development of feedwater conditioning to allow operation of these boilers without fear of costly outages caused by scale formation, corrosion and other difficulties incident to unsatisfactory feedwater. An excellent resume of these parallel developments has been recently published.[1]

First Operation in 1934

Another line of progress is the increasing number of boiler-plant installations for central or district heating, and the area covered by their distribution systems. In January, 1934, the United States Government completed and commenced operation of a central heating plant which today supplies steam for heating a total of about 300 million cu ft of Government-operated buildings in Washington, D. C.[2]

The tunnels and conduits of the distribution system, serving about 80 different buildings, are more than seven miles long and extend a maximum of nearly two miles from the plant. Of those designed solely for heating, this system is second in size in this country to that of the New York Steam Corp.

Total capacity of this plant is computed to be 1,100,000 lb of steam per hr at 200 lb per sq in. pressure, supplied from six 25,000-sq-ft cross-drum boilers, each capable of a continuous load of 215,000 lb per hr. Present connected load on the plant is more than 95% of capacity on the basis of zero degrees outdoor temperature, and additional buildings that will soon be connected are under construction. The ability of these boilers to fulfill requirements depends upon a continuous supply of adequately conditioned feedwater.

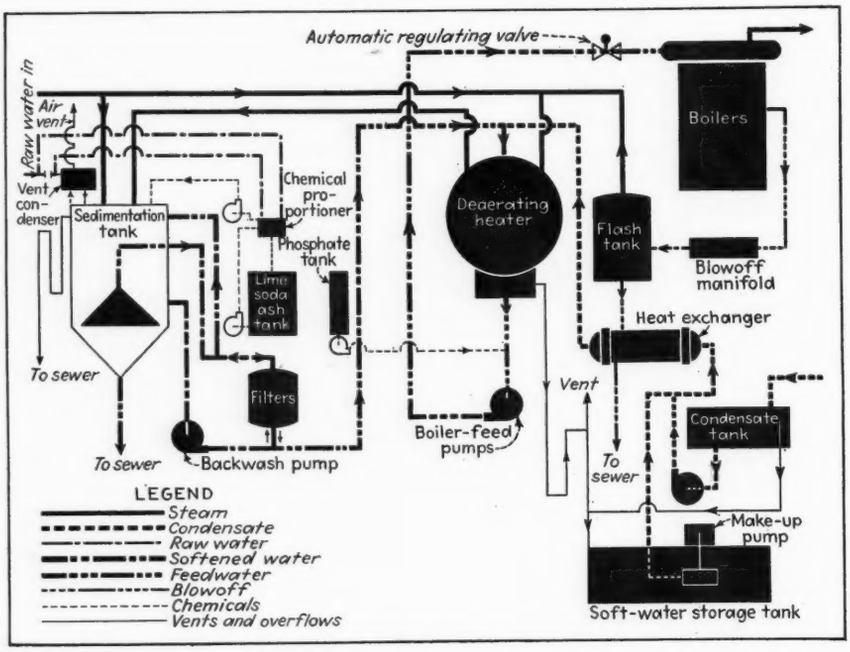


Fig. 1—Flow diagram of feed-treatment system at Federal Central Heating Plant

The water-conditioning system at the Federal Central Heating Plant is a continuous, hot-process, lime and soda ash primary softening unit supplemented by internal phosphate and sulphite treatment, deaeration, and continuous blowdown control. 50 to 60% raw-water makeup is required.

This system was selected after careful consideration of all types of water-conditioning equipment available at the time, and in view of other pertinent factors relating to the quality of raw-water supply available, quality of steam to be produced, and facility of operation. Improvements in operation of the equipment and control of water conditions have resulted from intimate studies during the past six years by a chemist in direct charge.

The diagram, Fig. 1, shows the cycle taken by the water through the various units of the conditioning system. Raw water, taken from the Washington municipal system, is bicarbonate in character, with a total hardness averaging about 80 parts per million as calcium carbonate.

Hardness is removed to an effluent value of 16 to 20 parts per million by the primary lime soda ash softener; the chemical reactions and subsequent separation of precipitated solids take place in a 70,000-gal. sedimentation tank.

Four horizontal closed filters remove the small amount of solids that fail to settle by gravity into the sludge cone of the sedimentation tank. Each of these filters has an area of 200 sq ft and can handle 3 to 3½ gpm per sq ft.

The entire primary softening system

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[1] Partridge, E P, and Purdy, A C, "Water Conditioning in Steam Generation," *Industrial and Engineering Chemistry*, Vol 31, pp 387-99 (1939).

[2] Barkley, J F, and Peters, C A, "Equipment and Operating Data on the Federal Central Heating Plant, Washington, D. C.," *Combustion*, November, 1936.

Central Heating Plant, Washington, D. C.

has a rated capacity of 70,000 gal. (583,000 lb) an hour, although the manufacturer has assured us that, with minor modifications to promote more rapid settling of solids, this capacity may be increased at least 20%.[3]

The supply of softened-water makeup required for boiler feed in addition to the condensate returning from the distribution system is automatically regulated at the deaerating heater where the second stage of water conditioning takes place.

Deaerating Heater

The deaerating heater has a rated capacity of 930,000 lb per hour. Here, the mixture of condensate return and treated water is dispersed into thin sheets and heated to boiling temperature in order to drive off dissolved oxygen and carbon dioxide which would cause serious corrosion of boiler surfaces. The effluent of the deaerating heater, discharging directly to the boiler-feed pumps, contains a maximum of 0.03 milliliters of oxygen per liter.

Steam for heating the water to approximately 220 F is supplied from turbine exhausts and from a flash tank where the continuous boiler blowdown, at 200 lb pressure, is reduced to atmospheric pressure. Gases driven from the water in the deaerating heater are vented with excess steam into the sedimentation tank where they are discharged to atmosphere through a vent condenser. Additional steam is supplied at the sedimentation tank to heat the city water and promote the chemical reaction rates and separation of the precipitate.

In the suction line of the boiler-feed pumps, a connection is made to supply a solution of sodium phosphate and sodium sulphite. This provides secondary lines of defense against the possibility of scale deposits resulting from the hardness not removed by primary softening, and against corrosion by the oxygen passing the deaerator. The salt of sodium phosphate known as sodium hexametaphosphate[4] is used to remove the scale-forming solids remaining after primary treatment; the reactions take place in the boiler drums with the formation of a sludge of such nature that it largely remains in suspension in the water and is passed out with the blowdown. The hexametaphosphate is used in preference to the orthophosphates because it does not form troublesome feed-line deposits, and by its alkali-reducing properties, it allows higher alkalinity of the feedwater without excessive alkalinity in the boilers.

Foaming and priming of boiler water with resultant carryover is prevented by a continuous blowdown system. Approximately 3 to 5% of boiler water is continually drawn off in order to maintain the concentration of dissolved solids in the boiler water within desirable limits. The heat in the boiler blowdown is largely recovered by utilization of the steam flashed off, and by passing the remaining water at atmospheric boiling temperature through a heat exchanger where a part of its heat is given up to the condensate being pumped to the deaerating heater.

Condensate Return

The condensate returning from the distribution system is passed directly to the deaerating heater, or to a hotwell storage tank where it may serve for makeup in the event of temporary outage of the softening system. The hotwell has a capacity of 1,500,000 lb of water.

The final stage of boiler-water conditioning—maintaining the proper sulphate-carbonate ratios for prevention of intergranular cracking, as recommended by the ASME boiler code—is controlled by additions of sodium sulphate to the feedwater. Although recent investigations[5, 6] have disclosed that these recommendations probably are inadequate, continued maintenance of the ratios is considered advisable pending alteration of the code.

The Central Heating Plant has been in operation for nearly six years without a single instance of boiler outage resulting from improper water conditioning. The boiler tubes have shown no evidence of scale or corrosion and the only evidence of either in the entire boiler has been a slight corrosion of the boiler drums during periods of standby. This has now been corrected by a dual blowdown manifold which allows return

[3] Private communication, Cochrane Corporation (1939).

[4] Hall, R E, and Jackson, H A, U. S. Patent 1,903,041 (1933).

Fig. 2—Boiler sludge and deposits in boiler lines are analyzed for CO_2 content

[5] Schroeder, W C, Berk, A A, and Fellows, C H, "Intercrystalline Cracking in Boiler Steel" *Journal American Water Works Association,* Vol 30, pp 679-94 (1938).

[6] Straub, F G, and Bradbury, T A, "Boiler Water Treatment—Methods Of Preventing Embrittlement" *Mechanical Engineering,* Vol 60, pp 371-6 (1938).

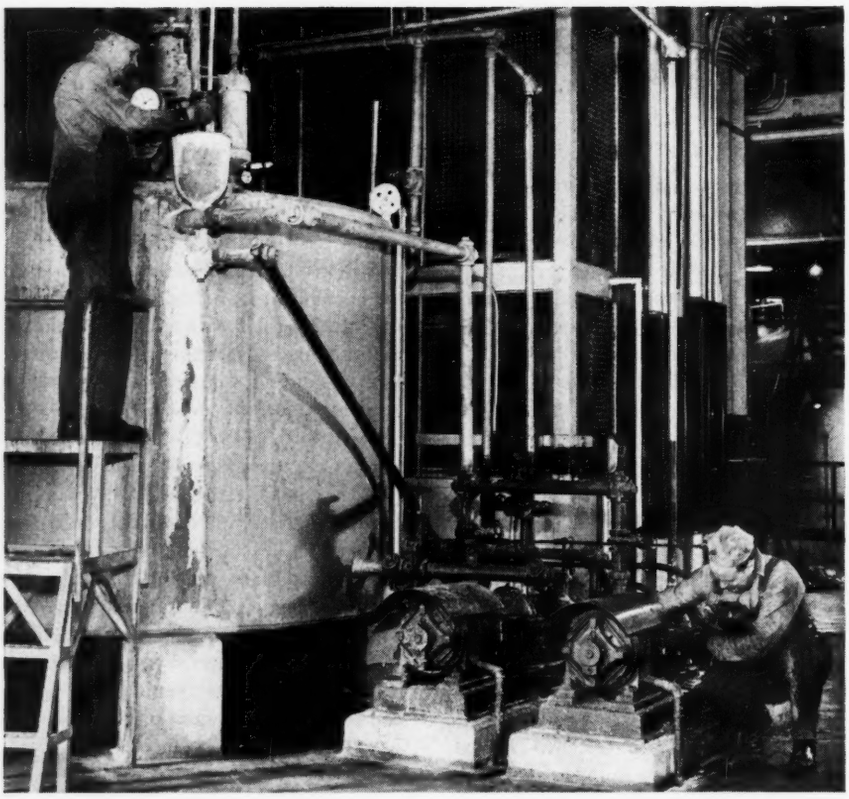


Fig. 3—A measured portion of a solution of lime and soda ash is continuously drawn from this tank and mixed with the raw water to remove scale forming solids

of a portion of the blowdown from boilers in service back to the idle boilers, thus utilizing the non-corrosive quality of the boiler water to protect the idle equipment. Idle boilers are cleaned when taken out of service, immediately filled with boiler water to the top of the drums and maintained under slight pressure to prevent in-leakage of air.

This method of caring for idle boilers has given entire freedom from corrosion but has resulted in accumulation of sludge in the drums and tubes. Consideration is now being given to the feasibility of extracting this sludge before returning the water to the idle boilers. Provision is also being made for utilizing deaerated feedwater under reduced feed-pump pressure to fill the idle boilers, although this is obviously not as perfect a non-corrosive medium as the concentrated boiler water.

Minor trouble has been experienced on a few occasions as a result of carryover, although the steam quality is normally better than 99%. Concentration of dissolved solids is maintained at approximately 1500 parts per million, although tests have indicated that 4000 parts per million may be carried without material increase in moisture content of the steam. The most serious damage resulting from carryover was the erosion of turbine blades. Cause of this, however, is not assigned to faulty water conditioning and has been largely overcome by installing efficient steam separators.

Although the sulphate-carbonate ratio established by the Boiler Code has been faithfully maintained, the possibility of its inadequacy has caused no great concern since the boilers are equipped with all-welded drums, and are consequently less subject to intergranular corrosion than riveted drums.

Instances of corroded steam and condensate piping in the distribution system, that might be attributed to inadequacies in water conditioning, have been relatively few. Principal difficulty has been experienced at points where high-pressure traps discharge into the main condensate return. Since the steam is generated from oxygen-free water, the only contaminating gas with corrosive characteristics that could be dissolved in the high-pressure drips is carbon dioxide derived from the conversion of sodium carbonate to sodium hydroxide in the boilers.

TABLE I — COST OF CHEMICALS FOR WATER CONDITIONING

Fiscal Year	*1935*	*1936*	*1937*	*1938*	*1939*	*Total*	*Average*
Steam generated — million lb	1,942	2,076	2,009	2,056	2,051	10,134	2,027
Lime used, lb	63,630	76,980	81,370	79,640	69,540	371,160	74,230
Cost of lime	$394.18	$469.14	$478.22	$476.08	$421.46	$2,239.08	$447.82
Cost of lime/million lb steam	.20	.23	.24	.23	.21	.....	.22
Soda ash used, lb	44,660	42,630	38,160	35,180	37,400	198,030	39,610
Cost of soda ash	$699.87	$639.38	$472.03	$453.20	$486.23	$2,750.71	$550.14
Cost of soda ash/million lb steam	.36	.31	.23	.22	.24	.....	.27
Phosphate used, lb	19,290	22,950	24,500	20,780	21,770	109,290	21,860
Cost of phosphate	$1,864.21	$2,111.79	$2,263.22	$1,866.23	$1,955.05	$10,060.50	$2,012.10
Cost of phosphate/million lb steam	.96	1.02	1.13	.91	.95	.....	.99
Sulphite used, lb	4,760	2,710	3,900	6,210	3,260	20,840	4,170
Cost of sulphite	$243.72	$96.86	$153.14	$235.23	$119.14	$848.09	$169.62
Cost of sulphite/million lb steam	.13	.05	.08	.11	.06	.....	.08
Sulphate used, lb	9,460	4,610	3,410	6,400	9,650	33,530	6,710
Cost of sulphate	$142.35	$69.34	$51.10	$115.55	$169.44	$547.78	$109.56
Cost of sulphate/million lb steam	.07	.03	.03	.06	.08	.....	.05
Cost of all chemicals	$3,344.33	$3,386.51	$3,417.71	$3,146.29	$3,151.32	$16,446.16	$3,289.23
Cost of all chemicals/million lb steam	$1.72	$1.63	$1.70	$1.53	$1.54	.....	$1.62
Cost of chemicals/million lb of makeup water treated, estimated at 50% makeup	$3.44	$3.26	$3.40	$3.06	$3.08	.....	$3.24

It is believed that the corrosive action of this carbon dioxide is accelerated by the presence of oxygen in the radiator returns of the main condensate line since action is primarily localized at the points where the drip lines are welded to the main return. This is borne out by the fact that there has been no instance where replacement of piping was necessitated where drip lines discharged directly to the sewer. Corrosion, where it has occurred, has been in the form of deep, sharp-cut pits without the usual rust tubercles, suggesting acid attack primarily. The studies of Collins and Henderson[7] indicate that carbon dioxide and the amount of solution flowing are the controlling factors of corrosion in steam-heating systems and little or no influence is exerted by small quantities of oxygen.

This is an interesting subject for a further investigation. A project is now under way for separating the drip lines from the main condensate return. This may throw some light on the primary factors causing this corrosion. Feedwater alkalinities are maintained as low as other considerations will allow, in order to reduce CO_2 to a minimum.

Primary Softening

Operation of the primary softening system has presented few problems of major consequence. The most serious situation has been corrosion of the 70,000-gal. sedimentation tank. Continuous load on the plant and lack of standby equipment has allowed thorough inspection of the condition of this tank only during the summer when load is at a minimum.

Inspection after the first season of operation disclosed no corrosion of consequence. It was noted in the following season, however, that the temperature of the water gradually decreased from about 218 to about 210 F and inspection the next summer showed a good deal of pitting in the tank. Lines were installed to enable sampling the water at different levels and it was found that it had an oxygen content of 2 to 5 parts per million, or ten times what should have been expected.

Investigation of the cause disclosed that the vent condenser tubes had corroded, allowing the raw water to be delivered to the tank without passing through the spray heater nozzles. These tubes were of admiralty metal and in some cases were almost completely eaten away by the action of the concentrated gases vented both from the raw water and from the deaerating heater. They were replaced with cupro-nickel alloy tubes, and periodic check of oxygen concentration was continued to insure that further corrosion is minimized.

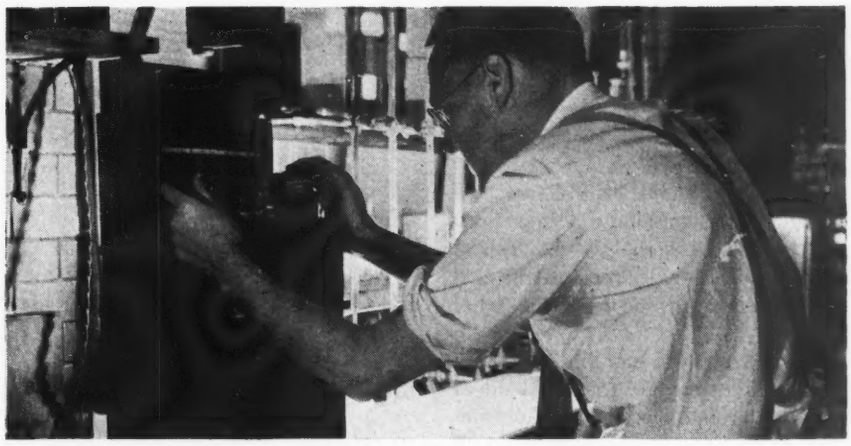


Fig. 4—Phosphate and pH determinations are made with this apparatus which compares the intensity of colors in relation to known standards

Some nuisance was created by continued stoppage of chemical feed lines from the chemical proportioner to the sedimentation tank, by deposits of lime and calcium carbonate. In an effort to overcome this, a recommendation was adopted employing the "threshold treatment"[8] property of sodium hexametaphosphate—adding a small quantity with the solution of lime and soda ash. This treatment appears to have had beneficial results although insufficient time has elapsed for definite conclusions. There was no measurable increase in hardness of the effluent water, as would be anticipated if too much phosphate were used at this point.

Daily laboratory control of water conditions has been maintained since the plant was first placed in operation. Routine analyses of softened-water makeup are made every three hours and samples of boiler water from each boiler in service are analyzed once a day. Determinations of hardness and alkalinity are made on the softened water; and alkalinity, phosphate, sulphite, sulphate, and chloride determinations are made on the boiler water.

Conditioning is regulated to reduce hardness as much as possible by primary softening without large excess of soda ash. This usually results in an effluent hardness of approximately 18 ppm of calcium carbonate and a boiler water alkalinity between 100 and 200 ppm of sodium hydroxide, which is about 80% of the total alkalinity. Sulphate is adjusted to maintain a 2 to 1 ratio of sodium sulphate to total alkalinity. Excess phosphate is adjusted to 40 to 50 parts per million of PO_4, sulphite to an excess of 30 ppm of Na_2SO_3, and chlorides to a value equivalent to approximately 1500 to 2000 ppm of total solids.

Constant attention is given to the latest advances in methods of water analysis to insure correct conditioning at all times. A recent development for the determination of hardness by the soap method[9] and a modification of the stannous-chloride colorimetric method for phosphate determination have been found advantageous.

Costs

Table I gives an analysis of the cost of the chemicals required for water conditioning. This shows that for an annual materials cost of about $3000 in a total operating cost of approximately $600,000, the dangerous hazard of tube failures and the nuisance and indeterminable cost of frequent turbining and tube replacements, have been entirely eliminated. The tubes have never required turbining, and the only tube replacements were necessitated by failure from erosion caused by too-close impingement of steam from soot blowers.

The cost of turbining and tube replacements that would be required if water conditioning were not applied would unquestionably be many times the cost of the water conditioning. In addition, the freedom from hazard and the knowledge that boilers will not have to be taken out of service because of scale or corrosion, are substantial assets.

[7] Collins, S F, and Henderson, E L, "Corrosion In Steam Heating Systems" *Heating, Piping, and Air Conditioning*, Vol 11, pp 539-42 (et seq) (1939).

[8] Rice, O, and Partridge, E P, "Threshold Treatment," *Industrial and Engineering Chemistry*, Vol 31, pp 58-63 (1939).

[9] Daugherty, T H, "The Soap Titration As A Measure Of Water Softening", Hall Laboratories, Inc, Copyright (1938).

Automatic Control Solves

Difficult combustion and steam-pressure problems, caused by widely fluctuating gas supply and steam demands, were solved by installing automatic combustion control on two boilers fired with oil-refinery gas and pulverized coal

By W E SACHSE
Instrument Engineer, The Standard Oil Co (OHIO)

▶ AT THE CLEVELAND, OHIO, refinery of the Standard Oil Co (Ohio), boilers are fired with coal, oil and refinery gas. The latter is a byproduct from the refinery processes and must be used when available; any fuel deficiency is made up with coal or oil. When all boilers were under manual control, we had difficulty in maintaining steam pressure without a large loss to atmosphere of gas, which was burned at the end of the discharge pipe from the relief valve.

Also, the rapid changes in gas supply hindered the transfer from fuel oil to gas burning and complicated the problem of maintaining stable refinery operations. After a study of several plans to reduce our fuel-gas loss to atmosphere we decided upon automatic combustion control for two boilers and installed a Leeds & Northrup system. Fig. 1 shows the control and meter panels; the master panel is in the center and the boiler-control panels are on the ends.

The Boiler Plant

We have eight Vogt 9-drum boilers, each rated 26,000 lb of steam per hour, four of which can supply our normal load. Three boilers are equipped with chain-grate stokers, three have combination oil and gas burners and two can burn pulverized coal or gas. Each of the latter has two Foster Wheeler combination coal, gas and oil burners and a pulverizing mill.

Refinery gas is supplied to the two boilers under automatic control through a backpressure regulator in the gas main. This regulator functions to maintain the refinery-gas supply at a constant pressure by allowing only gas in excess of that required by the refinery to go to the boilers. The control arrangement of these two boilers is such that all excess gas normally available will be burned and any deficiency in fuel is automatically supplied by burning pulverized coal.

When steam demands or the excess-gas supply or both are such as to reduce the rate of pulverized-coal firing below 80% boiler rating, control of the fuel to the boiler is automatically transferred to the gas-backpressure regulator. Any further reduction in fuel supply is taken care of by adjusting the backpressure valve to decrease the gas supply to the boilers. Control of the backpressure is taken over by only one of the two boilers, which one being determined by the setting of a selector switch.

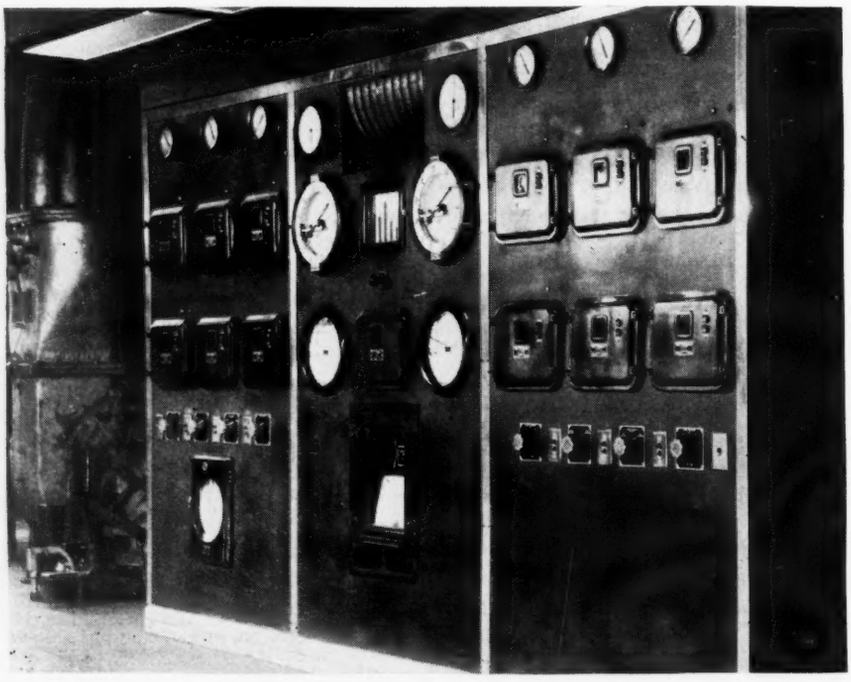


Fig. 1—All meters and automatic-control equipment to operate two boilers under practical test conditions are on these panels

Fig. 2 is a schematic layout of one boiler-control panel and its connections to the master controller. The master, as previously mentioned, is on the center panel, Fig. 1, and has its actuating element, a Bourdon tube, connected to the steam header. An air-loading line from the master connects to a total-fuel and an air-flow controller. A manometer in the air-flow control connects across an orifice O in the secondary-air duct. Differential pressure across this orifice is balanced against the master loading pressure in the air-flow controller. Closing and opening of the contacts in this unit positions the damper in the secondary-air duct.

Fuel Measurement

A manometer in the total-fuel controller connects across an orifice O_1 in a branch from the air-supply line. This line terminates in two branches, each with a bleed-off orifice and a power-operated valve. In this pipe assembly, the orifice in the main air line represents the total fuel, that in one of the branch lines measures gas flow and the other coal flow. To do this, one of the branches connects to the loading diaphragm in the pulverized-coal-mill air-flow controller and the other to the loading diaphragm in the gas-flow controller.

Loading pressure on the mill air-flow controller is balanced, through a manometer, against the differential

Dual-Fuel Problems

across the pulverized-coal mill. In the gas-flow controller, differential pressure across an orifice O_2 in the gas main balances through a manometer the loading pressure of the air line. Contacts in the mill air-flow controller connect to the mill-exhauster-damper power unit. In the gas-flow controller the contacts connect to a power-operated valve in the loading-orifice line. The furnace-pressure regulator contacts connect to the uptake-damper power unit and the mill-pressure-controller contacts connect to the power unit on the primary-air damper in the mill-air intake.

Operation of Control

Assume that the boiler has been operating on constant load and that all the available gas is being burned when there is an increase in steam demand. This will produce a slight drop in steam pressure, which will cause the master to increase the loading air pressure to the air-flow and total-fuel controllers. Contacts on the air-flow controller close and energize power unit M (Fig. 2) to open the secondary-air damper to supply more air to the furnace. This damper continues to open until the differential pressure across orifice O balances the increased loading pressure on the air-flow controller and its contacts open. The increase in air flow is directly proportional to the increase in the demands for steam.

Increased loading pressure on the total-fuel controller closes contacts to energize valve V in air line A and this valve starts to open to increase the air-loading pressure on the mill air-flow controller. Valve V continues to open until the increase in differential pressure across orifice O_1 again puts the total-fuel controller in balance.

Contacts on the mill air-flow controller close to energize power unit M_1 on the mill-exhauster damper to increase the primary-air and coal flow to the boiler. When the mill-exhauster damper starts to open, it causes a drop in pressure at the mill intake and increases the differential pressure across the mill. A drop in pressure at the mill intake closes contacts on the mill-pressure controller which energizes unit M_2 to open the primary-air damper.

This damper opens until the pressure at the mill intake is restored to its constant normal value; then the mill-pressure controller is again in balance. The mill-exhauster damper continues to open until the increased differential across the mill balances the increase in loading pressure on the mill air-flow controller and its contacts open. Furnace pressure is held constant by the furnace-pressure controller energizing power unit M_3 to open the boiler-uptake damper.

For a decrease in steam demand, the opposite of the operations just described takes place.

As previously mentioned, the gas-backpressure valve V_2 normally functions to maintain a constant pressure of 10 lb on the supply side of the valve. Assume that the boiler is operating under constant load with stable combustion conditions when the gas supply increases beyond that required for process. Pressure in the gas-supply line will start rising and the gas-backpressure regulator will open valve V_2 to admit the excess gas to the boiler-fuel line. Now, too much fuel is being supplied to the boiler. To correct this, added gas flow through orifice O_2 increases the pressure differential across this orifice, which in turn upsets the balance of the gas-flow controller. Bleed valve V_1 is now opened farther, by contacts closing on the gas-flow controller, to increase the loading pressure until the controller is again in balance.

Opening valve V_1 increases the air-flow through orifice O_1 and the increased pressure differential across it puts the total-fuel controller out of balance. This controller then closes contacts to start closing bleed valve V to unload the mill-air-flow controller. This controller in turn closes contacts that energize power unit M_1 to reduce coal flow to the furnace, in proportion to gas-flow increase, by partly closing the mill-exhauster damper. Differential pressure across the mill decreases to balance the air-flow control. Increase in air pressure at the mill intake operates the mill-pressure regulator to close partly the primary-air damper to maintain constant pressure at the mill intake.

The preceding two paragraphs explain how the rate of firing is reduced

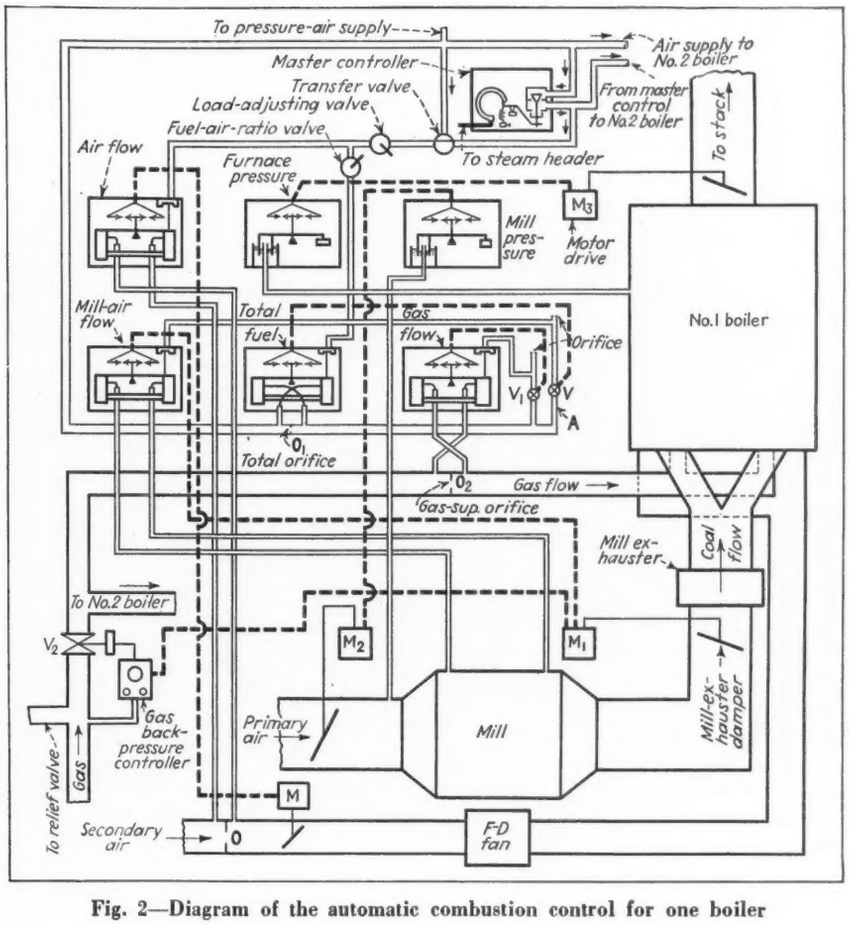


Fig. 2—Diagram of the automatic combustion control for one boiler

until a predetermined minimum of coal burning is reached. At this point, the mill-exhauster damper stops closing and the control of fuel feed to the furnace is transferred to the gas-back-pressure valve V_2 by a connection between its controller and power unit M_1 on the mill-exhauster damper. Gas to the furnace above that needed for minimum firing causes the steam pressure to rise slightly and the master controller reduces the loading pressure on the air-flow and total-fuel controllers, which causes the system to function to reduce the secondary air and fuel feed.

The power unit, instead of closing the mill exhauster damper, closes the back-pressure valve in the gas main to reduce gas flow to meet steam demands. Gas pressure increases in the main to where the relief valve opens and any excess gas blows to atmosphere and is burned. When the load picks up on the boilers again, first the gas-pressure valve is adjusted to normal, and any steam demand beyond that of the available excess gas is picked up by increasing the coal-firing rate.

In addition to the combustion-control system, the raw-coal feed to each mill is regulated automatically by the differential across the mill coal level. A control unit actuated by differential pressure across the mill exhauster trips the mill primary-air-inlet and mill-exhauster dampers to prevent flash-backs into the mill if the exhauster stops. During normal operation the mill-exhauster damper is prevented from closing to less than 80% boiler rating position by a minimum limit switch on the damper drive unit. This is necessary because the amount of fuel gas available changes so rapidly.

With two boilers on automatic control we can handle 75,000 cu ft of gas per hr, which under normal conditions prevents any loss of gas to atmosphere. The automatic combustion-control system has reduced our fuel gas losses to a negligible quantity, except during emergency conditions, has improved the boiler-plant efficiency and made it much easier for the operators to handle boilers.

Safety Precaution

As a safety precaution we still keep a small gas pilot burning in flare, at the discharge end of the pipe from the gas-relief valve, to ignite any excess gas discharged to atmosphere. We also keep a small gas pilot burning at the burners of each controlled boiler so that if the fire should go out, because of a sudden loss of fuel, ignition will occur immediately when fuel returns.

All instruments are mounted on the panels with the automatic combustion-control units. The metering equipment for each boiler includes a steam flowmeter, CO_2 recorder, stack-temperature recorder, a multi-point draft gage, steam-pressure gage and a mill-level gage. Coal- and gas-combustion rates are indicated by gages on the boiler-control panels. These gages connect to the air-loading lines of the control units. Each combustion-control drive unit has an upper- and lower-limit signal light above its controller on the panel board.

Transfer, load-adjustment and fuel-air-ratio valves and individual control-unit selector switches permit operating the boilers any desired way under either automatic or manual control. By using these meters and the combustion-control system, the men in charge of the boilers can operate them under practical test conditions at all times.

Before we installed automatic combustion control, steam pressure was held at 165 to 175 lb per sq in and lowered to 150 lb by reducing valves in the steam lines leaving the plant. After installing automatic control we reduced steam-header pressure to 150 lb and removed the reducing valves. Fig. 3 is a typical steam-pressure graph taken from the boiler plant steam header. This shows that we can now maintain constant pressure with varying steam demand, as shown in Fig. 4, and a rapidly changing gas supply.

Two of the four boilers, normally operated to supply the refinery steam demands, are based loaded at 150 to 200% rating and the two under automatic control take the load swings. We can also operate one boiler on automatic control to take the load swings and three on base load. This arrangement is not desirable, however, because of the reduction in the amount of gas fuel under automatic control.

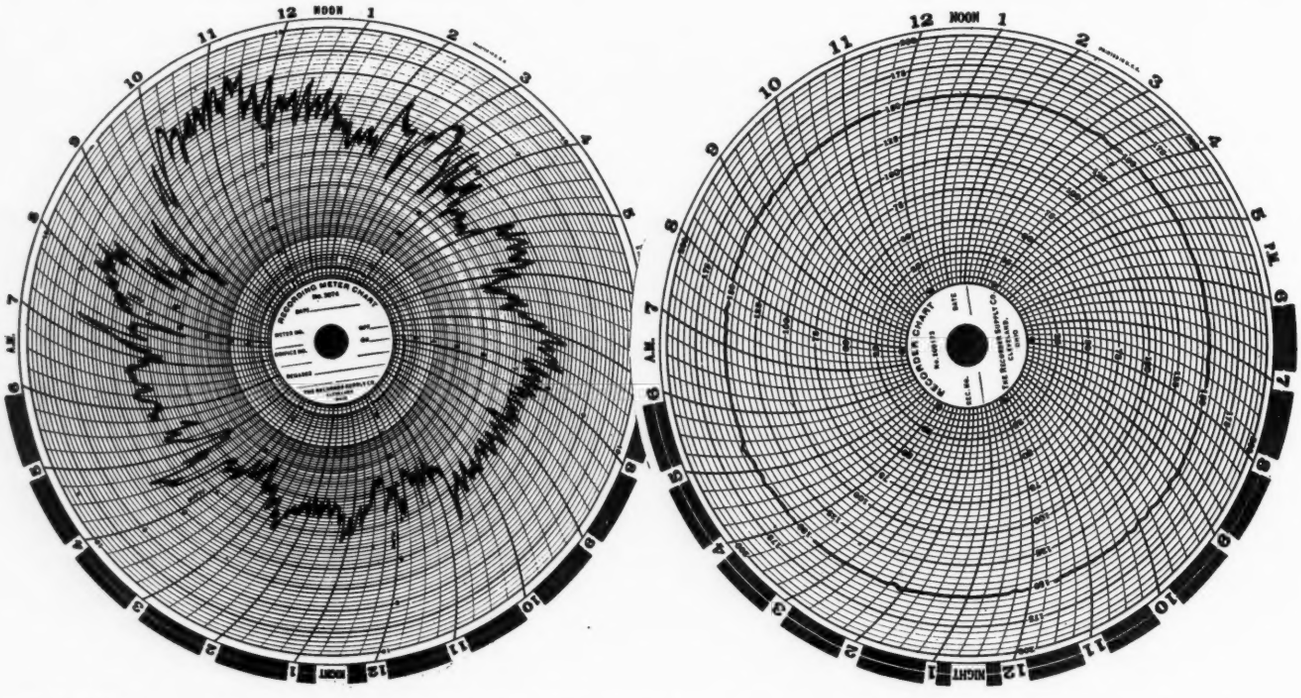


Fig. 3 (right)—Typical recording steam-pressure-gage chart obtained with automatic-control equipment, when steam demands vary as shown by the recording steam-flowmeter chart, Fig. 4 (left)

Compressor Plant Modernization Pays for Itself Out of Savings

W J Crabbs, Jr, Western Maryland Railway Co, shows how new steam-driven air compressor with aftercooler and improved cooling-water system reduced operating costs $1100 per month

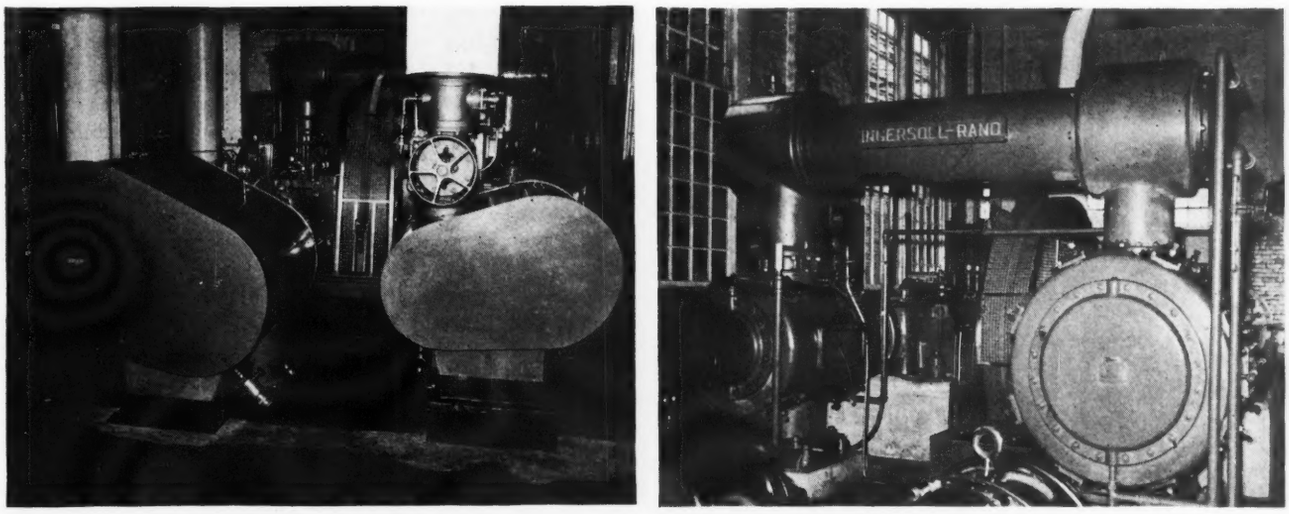


Fig. 1—New compressor has 19x24-in. and 30x24-in. cross-compound steam cylinders; 30x24-in. and 19x24-in. air cylinders, Fig. 2

► IN ITS MAINTENANCE SHOPS at Hagerstown, Md., the Western Maryland Railway Co uses large volumes of compressed air for sand blasting, paint spraying, testing and charging train brakes, powering air tools and for many other purposes. Until the middle of 1939 this air was supplied by two units —one, a 2000-cfm, cross-compound, steam-driven compressor having corliss air-inlet valves and slide valves on the steam end. The second unit was a 2500-cfm, synchronous-motor-driven, plate-valve compressor.

After 25 years of service the steam-driven unit was in poor condition and did not have sufficient capacity for shop demands. We operated the motor-driven compressor during shop hours and used the steam-driven machine nights, weekends and holidays.

We have our own boiler plant which must be kept fired at all times to supply steam hammers, boiler-wash pumps and for blowing locomotive fires. When these are the only demands, boiler load fluctuates very badly, requiring periods of banked fires and others of forced firing. Naturally, low boiler efficiency resulted. This condition was further aggravated by live steam demands for feedwater heating when the motor-driven compressor was operated.

New Unit Selected

Thus, it was possible to run the steam-driven compressor with little or no increase in boiler-plant operating cost, because it reduced steam-load fluctuations and supplied low-pressure steam for feedwater and other heating purposes. However, the unit did not have sufficient capacity and extensive repairs would be required to restore it to efficient operating condition. This latter could not be justified economically because the compressor was of obsolete design.

A study of the compressed-air plant's operating costs and conditions showed that:

1. The motor-driven compressor, although 17 years old, had always been dependable and was capable of taking on the entire load satisfactorily at any time. A few repairs had put it in good condition and practically restored its original capacity. Its 5-step-clearance-control permitted the machine to handle load variations easily and efficiently.

2. To assure 100% availability for shop operations, it was desirable to have an alternate method of drive capable of supplying the entire load under maximum conditions.

3. A reliable steam-driven compressor of about 2500-cfm capacity, with suitable regulating devices to cope with extreme variations in air demand, would carry the entire load 24 hours a day with practically no increase in total coal consumption because of improved boiler conditions mentioned previously.

As a result of this investigation, an Ingersoll-Rand, steam-driven, 2650-cfm, duplex-type compressor was installed during July, 1939, to take the place of the old one. The new unit has

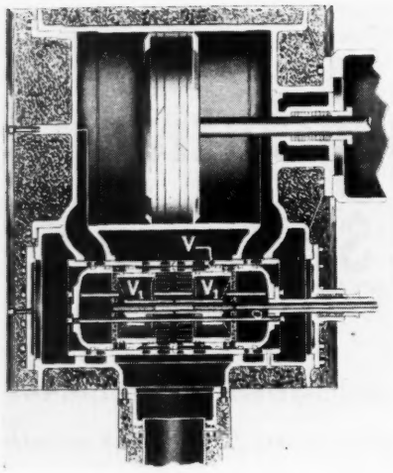


Fig. 3—Cross-section through piston valves with two adjustable cutoffs

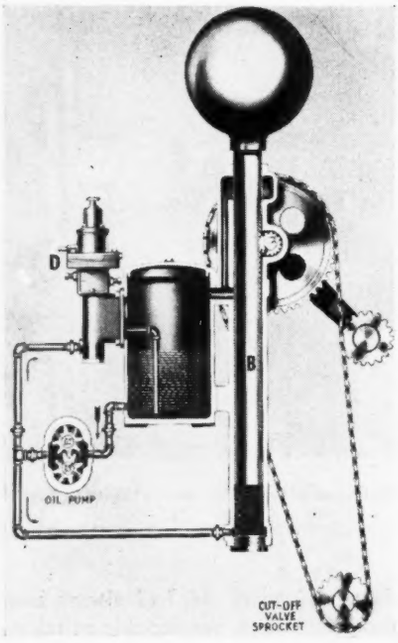


Fig. 4—Governor automatically adjusts cutoff valve for speed control

19x24-in. and 30x24-in. cross-compound steam cylinders on one end of the frame, Fig. 1, and 30x24-in. and 19x24-in. 2-stage air cylinders on the opposite end, Fig. 2. It is much more compact and requires less space than the old compressor.

As air and steam cylinders are on opposite ends of the frame, forming a 4-corner construction, operators are able to get at any one cylinder without disturbing the others. The steam receiver between high- and low-pressure cylinders is out of the way below the floor. Except for periods of inspection, the new compressor has been on the line continuously since its installation and has met all requirements.

Steam valves are of the balanced-piston type, Fig. 3, having two cutoffs valves V_1 which telescope within the main valves V. The two sets of valves are driven by separate eccentrics. One of the cutoff valves is right-hand and the other left-hand threaded on its valve stem. Then, by rotating the stem in the proper direction, the governor automatically adjusts the cutoff.

Oil pressure from a fully enclosed chain-driven oil pump acts on the governor-weight stem B, Fig. 4. A governor diaphragm connected to air-receiver pressure controls a bypass valve at D. This bypass independently influences the oil pressure under the governor-weight stem B, causing the weight to rise and fall according to air-pressure variations brought about by changes in demand for air. Thus, the governor automatically adjusts the cutoff to run the compressor at a speed just sufficient to maintain the desired air pressure. The governor does this regardless of demand for air or variations in steam pressure.

Constant Pressure

Rated full speed of the compressor is 155 rpm, but it operates between this and 15 rpm and holds the air pressure constant within 2 lb. The compressor is efficient at partial loads because any losses in mechanical efficiency and increased steam-cylinder condensation are counteracted by better efficiency of compression at the slower speeds.

A safety-stop valve shuts off steam in case of overspeeding, stalling of the unit or failure in lubricating-oil pressure. This safety-stop valve is closed by a weight arm, and held open by a latch and pin. The pin drops out of position and releases the drop valve whenever the oil pressure falls below a set value. If the machine overspeeds, a chain-driven centrifugal knockout device trips a bleed valve in the lubricating oil system, instantly releasing the shut-down device. The safety stop functions every time the compressor is stopped intentionally. It must be reset before the machine can be started, and thus gives protection against sticking or freezing due to lack of use. Since there can be no lubricating-oil pressure until the machine starts, a starting pin holds the shut-down safety device open and displays a red warning signal until pressure builds up.

Only half as much cooling water was used for the new installation in August as for the motor-driven unit in July. This saving was due to the more efficient intercooler and better cylinder water-jacketing, and an improved method of water circulation, Fig. 5. Normally valves A and B are closed and C open so that the same water flows through all elements of the compressor plant, including an aftercooler installed at the same time as the compressor. The water circuit begins at the main and goes through the aftercooler, then to the intercooler, low pressure cylinder and finally to the high-pressure cylinder and to a tank on the roof. From there water flows by gravity to the feedwater heater and is pumped into the boilers by a 2-stage, 75-gpm, 3500-rpm Ingersoll-Rand motor-pump.

Cooling-Water Circuit

This water circuit provides coldest water for the aftercooler and intercooler, and a cylinder-jacket temperature cold enough for efficient compression. The water is warm enough (about 115-F outlet temperature) to prevent condensation from the air in the cylinder passages. The latter would tend to interfere with proper cylinder lubrication and cause rusting within the air passages. A moisture trap and automatic float-valve ejector built integral with the intercooler prevent condensation and water leakage being carried into the high-pressure cylinder.

Closing valve C and opening A and B permits using cold water from the mains direct to both the intercooler and aftercooler for full-load conditions during hottest summer weather.

The motor-driven compressor, until experience showed the savings resulting from the new water circuit, had separate water connections to each cylinder and the intercooler. Now, it too uses the series circuit.

Aftercooler Dries the Air

Before the new compressor with its aftercooler was installed, men in the shop wasted considerable time and compressed air in blowing water, moisture and oil out of air lines before they could use air tools. Even then, some moisture was always carried along, which tended to wash lubricant out of the tools. In winter this condensation would freeze and was a source of trouble in the outside distribution system for train-line charging.

The aftercooler, by removing moisture from the air at the compressor plant, eliminates all of this trouble and expense. It also improves sandblasting conditions. This 2-stage aftercooler with integral moisture separator has an automatic water ejector. Piping has been installed so that the aftercooler can serve either the electric- or steam-driven machine or both, or can be bypassed when necessary.

Accurate cost comparisons are difficult because of varying uses of both

steam and air throughout the shop. However, during July while the new compressor was being installed, the electric-driven unit carried all the load. During this period the actual amount of work turned out by the shop and the total number of trains dispatched was almost identical with that in August, when the new steam machine supplied the load.

Savings Obtained

Records show that power-house coal consumption for all purposes was practically the same both months, including coal to run the steam compressor in August. This is attributed to better load balance on the boilers, and to the economical performance of the new compressor. It substantiates previous indications that the new steam compressor could be operated continuously without expense for steam.

Power required by the electric-driven compressor in July was a direct saving in August. Add to this the decreased cooling-water for the new installation and we get a saving of approximately $1100 per month.

Largely responsible for the economical compressor performance are the modern air cylinders equipped with channel valves, the piston-valve steam-end, and the oil-type, automatic cut-off, speed-pressure governor.

Our distribution main for train-line charging is nearly two miles long, the first take-off being about 3000 ft from the compressor plant. With longer trains and the adoption of a new air-brake system, requiring more air for testing, the original 2-in. pipeline caused a pressure drop which often slowed up charging operations. At the far end of the line, two 9½-in. single-acting pumps boosted the pressure for operating air tools, now and then, in a separate car-repair shop.

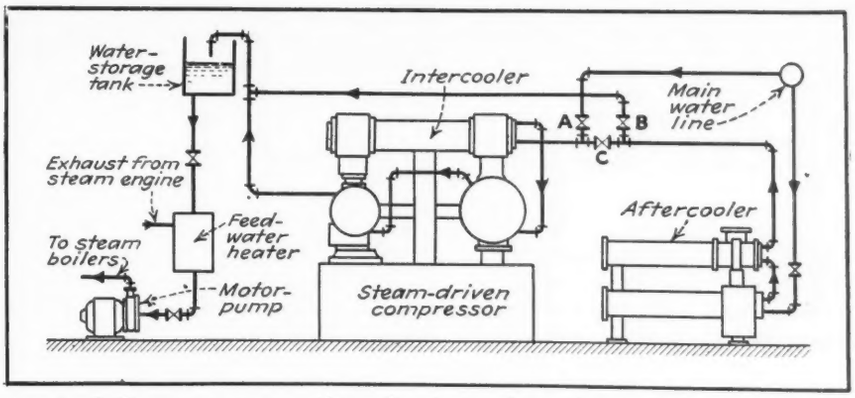


Fig. 5—Cooling-water system—aftercooler, intercooler and compressor cylinders are all in series, an arrangement that saves cooling water

Before the new steam compressor was purchased, we considered installing a 75-hp, motor-driven, 2-stage, air-cooled compressor at the end of the line. With automatic start-and-stop control, and air cooling to eliminate freezing hazards, such a unit would have required very little attention. At the same time, it would relieve the main compressor plant of more than 300-cfm load, and make possible greater use of the original steam compressor. However, since this section of the yard did not have electric power, the installation cost of an electric-driven unit was quite high.

Increased Pipe Size

Gasoline- and oil-engine-driven units were also considered, but these would require an attendant for starting and general care, anti-freeze, etc. To solve this problem, we replaced 3000 ft of old 2-in. pipe by 3-in. Now there is adequate pressure at the tracks, where a reducing valve maintains 70-lb pressure. The steam power to compress the air is practically free, and the air-driven booster is used only infrequently when necessary to supply the air-operated tools with high-pressure air.

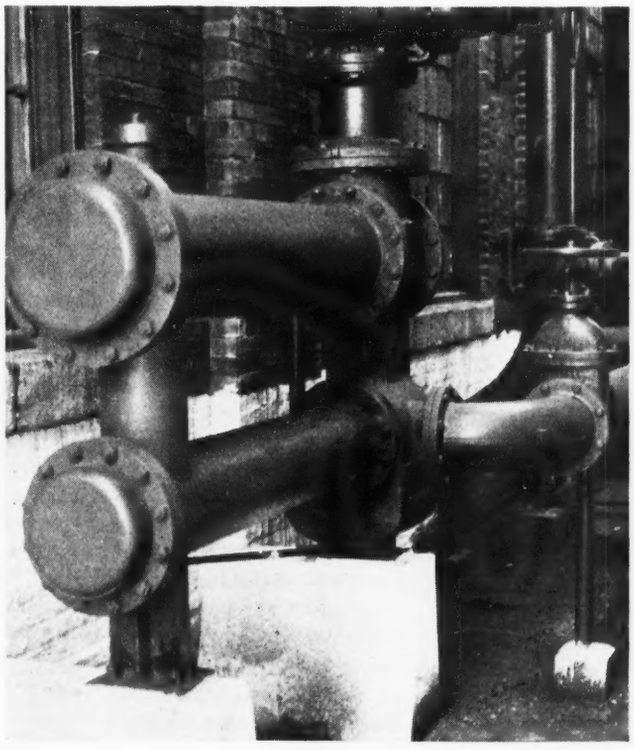


Fig. 6—Aftercooler is installed so that it can serve either the steam- or the motor-driven units

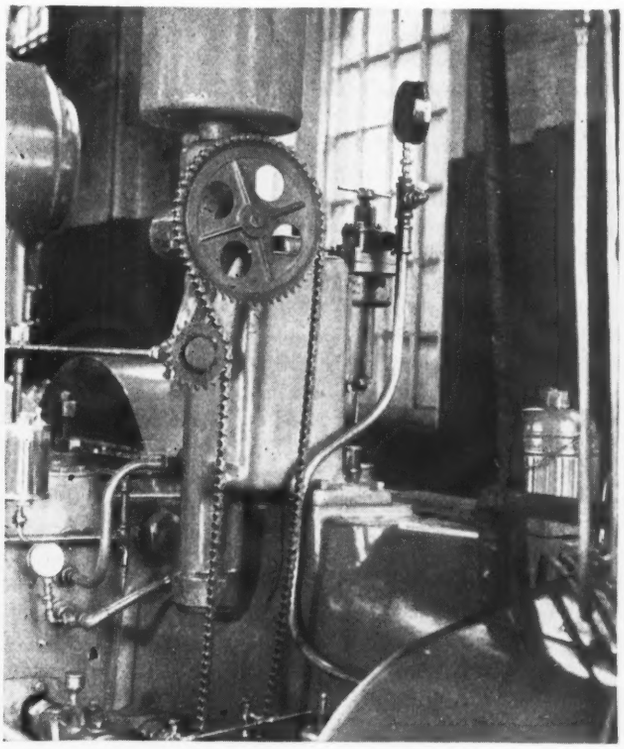


Fig. 7—Automatic governor adjusts compressor speed to hold air pressure constant within 2 lb for speed of 15 to 155 rpm

Hotel New Yorker Goes Back to Coal

Warren Lewis, chief engineer, tells how changing from oil to "de-dusted" coal promises a net fuel-cost saving of $20,000 for 1940, proving the advantages of a "2-fuel plant"

▶ BEFORE DISCUSSING the reasons which prompted the change from oil to coal at the Hotel New Yorker on Jan 1, 1940, it might be well to mention briefly the original boiler equipment and the changes made in the 10 years since the hotel opened, although several previous articles in POWER have covered this ground thoroughly. In October, 1929, before the hotel opened for business, we installed four 6500-sq-ft, 225-lb, 425-F, cross-drum Heine boilers, each equipped with a Riley Atrita pulverizer and natural-draft burners. Actual evaporation obtained averaged 9.36 lb per lb of coal; it is interesting to note that this fell right between the 10.5 lb estimate of the optimistic designing engineers and the 8.5 lb predicted by the public utility engineers.

Changed to Oil in 1934

The plant burned coal for five years until, toward the end of 1934, a gradual increase in coal prices and a corresponding drop in fuel-oil prices made it economical to install oil burners and necessary auxiliary equipment. We insisted on adding the oil-burning equipment, together with forced-draft fans, to the existing pulverizer system, with the result that Peabody combination coal-and-oil burners designed to operate with forced draft were selected and installed; these units have proven their reliability and efficiency during the past 5 years.

Savings from the change-over paid for the entire cost of oil-burning and forced-draft equipment in 20 months. A large share of the credit for quick amortization goes to the high efficiency of the new oil-burning equipment; actual evaporation averaged 14.5 lb per lb of oil with 15% CO_2. Details of this installation and the results obtained appeared in POWER, December, 1935.

In making the changeover, the original pulverized-coal burners, which were quite large to permit natural-draft operation, were displaced by much smaller burners designed for forced draft. As these had only been tried out during the installation period, to be sure they worked properly, we decided, after burning oil for a year, to try out the new coal-burning equipment to get some idea of its operating efficiency. Consequently, the plant operated on coal during October, 1935. While it was impossible to get maximum results over this short trial period, evaporation for the month averaged 10.3 lb per lb of coal, and we estimated that it would come up to 10.5 under more favorable conditions.

We burned oil for more than 5 years, but the steady increase in prices during the latter part of 1939 made it impossible to renew the contract for our requirements at a resasonable increase in cost. Bids submitted during the latter part of 1939 showed an increase of more than 1 cent per gal, and indicated an increase in fuel cost for 1940 of more than 45%, as compared to 1939. When you stop to think that yearly oil consumption at the New Yorker approximates 3,300,000 gal, even a 1 cent per gal rise means a yearly addition to the fuel bill of $33,000.

On the other hand, fuel oil had been burned with marked satisfaction, not alone for the ease of operation and the high efficiency obtained, but particularly because of its cleanliness. A modern hotel operates on the basis that everything must be spotless; dust and dirt, or anything that produces it, is taboo. Probably the most serious managerial objection to burning coal in the past has been the dust which blew around the streets, even entering the lobby and basements through the freight-elevator shafts.

So it was with understandable reluctance that we investigated coal prices and compared them with oil, basing our calculations on the coal-burner tests made in 1935. We immediately discovered that coal offered considerable savings, and after investigating the problem from all angles, we were satisfied that a net saving of $20,000 could be made in 1940 by shifting to coal. Further investigation revealed that oil-treated coal would fit our requirements and would materially reduce the dirt.

A few days before the first of this year, we literally "dusted off" the coal-burning equipment and put it back in service, none the worse for a 5-year vacation. The oil-treated coal proved a revelation as it produced practically no dust and the evaporation eventually averaged above our estimate of 10.5 lb, at times. Complaints from other parts of the hotel about the dirt have been less than ever before. The oil treatment did not affect the free-flowing quality of the coal and seemed to assist in shedding water, especially from bad rains.

While the actual changeover from oil to coal proved quite simple, obtaining the desired efficiency turned out to be another matter. Even the older employees who were familiar with coal burning had to learn all over again because of the forced-draft. We had worked out methods of maintaining the proper fuel-air ratio with oil but when we started to burn coal with forced draft we found the blowers delivered too much air, especially on the night watch when load was light.

Fan-Speed Control

In accordance with the original plant design, the blowers were able to furnish the air needed when burning oil at 200% of boiler rating, although most of the time they carried less. On coal, the pulverizers supplied, according to the builder's rating, 15% primary air at 200% rating or about 20% at 150% rating. Thus the fan was only called on to supply 80% as much air as when burning oil. Use of 230-volt, dc, constant-speed shunt motors precluded field control, so we obtained prices on armature-resistance controls, which proved too high.

Then, we made a check on the fan load at different speeds and, after considerable testing to verify the calculations, we installed two double-throw, 3-pole switches with one pole in each of the armature, field and control circuits so that line voltage could be changed on armature and field at will. This gave results as follows:

Speed	*Armature Voltage*	*Field Voltage*	*Rpm*
High	230	230	1150
Int	115	115	840
Low	115	230	570

Warren Lewis, chief engineer of the Hotel New Yorker since the building was put up in 1929, is the kind of a man you'd want on your side if you were choosing up sides to run a power plant. He can field as well as hit

With this speed variation, the combustion control could more accurately control air volume under either heavy or light loads.

We had on hand nearly enough material to renew worn parts on two pulverizers so two were overhauled. On the other two we followed the manufacturer's advice and rebuilt the machines to take advantage of design improvements made during the 5-year shutdown. Insufficient experience with the redesigned units makes definite comparison impossible, but the "new" pulverizers are superior in pulverizing ability and we anticipate highly satisfactory operation.

Can Handle Cheaper Coals

We now take advantage of one improvement resulting from the installation of forced-draft fans; with natural draft and limited control of combustion, only low-volatile coals could be burned. Now, a wide range of fuels can be handled, many costing from 6 to 8% less than the premium coals we formerly had to consider. Although furnaces are large, contributing to good combustion, they are of brick construction, waterwalls having been eliminated for the sake of simplicity and economy in the original installation. So, while we anticipate being able to burn all high volatile coals successfully, for practical reasons we have to restrict our choice to those with high ash-melting point, as there is no provision for removing slag. We are now testing coals to find those that give lowest all-around steam cost, and expect that these tests will also show the minimum ash-fusion temperature permissible.

A major advantage of a "2-fuel" plant such as that at the New Yorker lies in the ability to make a change of the type described without installation costs. A change from one fuel to another is an operating change that costs the management nothing and this avoids the need for asking an "appropriation." From an operating standpoint there is a big advantage in having a "spare" fuel for emergencies, especially in a plant that is without outside power supply and so must rely on its own resources entirely.

Changeover from one fuel to another is now exceedingly easy. When we gave up oil and went back to coal, each pulverizer motor was inspected and blown out. Coal scale mechanism and motors got similar treatment, after which bunker gates were opened so coal could flow to the scales. This coal was automatically weighed and passed to the pulverizer hopper; then it was only necessary to start the pulverizer motor, adjust the coal feed and the plant was burning coal, ignition from the oil being automatic. Shutting off the oil and withdrawing the oil burner and casing completed the changeover. From all this it can be seen that if the coal is left in the chute and pulverizer hopper, merely starting the pulverizer motor swings the plant to coal.

To reverse the process, we start the oil pump and recirculate the heavy fuel oil through the heaters, if time permits, until it is hot enough to handle properly. Pushing the oil burner casing and diffuser back into the furnace, inserting the burner and lighting off from the coal flame complete the job. Pulling the oil burner casing and diffuser back into the coal burner while burning coal protects it from the intense heat of the furnace and it can remain there indefinitely, ready for instant service.

2-Fuel Plant Pays

Results at the New Yorker definitely prove there are many advantages in a 2-fuel installation. Our experience shows that both fuel oil and coal do not as a rule reach and hold peak or equivalent prices at the same time and fuel markets have been so erratic the last few years that being able to take advantage of the lower prices of either fuel means real savings in steam costs.

The following points sum up a few of the features of the Hotel New Yorker boiler room which have proved desirable in obtaining both economy and reliability.

1. Mechanical handling of coal and ashes holds down labor cost, making them comparable to costs with oil.
2. Ability to burn two fuels serves as insurance against shutdown from fuel failure—either in equipment or delivery.
3. Large furnace volume helps obtain complete combustion with resultant high CO_2 and good evaporation.
4. Installation of forced-draft combination burners capable of handling either fuel over wide load range, with maximum efficiency, proved highly satisfactory from an operating standpoint.
5. Combustion control with CO_2 meters to check operation is an absolute necessity. The CO_2 meters, original equipment, are maintained as faithfully as the boilers they serve. Not only does the operating staff check their accuracy regularly, but service men from the maker check the instruments periodically.

What Diet for Your Diesel?

Feeding your engine with proper fuel and lubricating oil means better performance and freedom from trouble. Second of three articles in which S S Hansen, Chief Lubrication Engineer, General Petroleum Corp, tells how to keep diesels "in the pink"

▶ IT'S POSSIBLE TO BURN almost any liquid fuel in a diesel, but every operator knows that a more or less narrow range of fuels gives best results on a particular engine. Likewise, every operator knows that some lubricating oils do better jobs than others. However, the rub comes when we face the job of finding the right diet of fuel and lube oil for the engines in a particular plant. There aren't any hard and fast rules, so the operator must know how the various oil characteristics affect engine performance and how to weigh their importance in his own case.

Table I lists the most important characteristics of a diesel fuel which must be considered in determining its quality, and gives recommendations as to the general class of fuel suitable for various engine types. However, the first physical characteristic of a fuel which must be given practical consideration is its "pumpability" at the lowest atmospheric temperature at which it is intended to be used. Table II defines specific temperatures at which diesel fuels, of both naphthenic and paraffinic types, may be safely handled.

Consider Viscosity

After the operator has checked the practicability of using a certain fuel from the standpoint of pumping, he should consider the fuel's viscosity. This, of course, bears a close relation to pumpability; that is, the viscosity should be low enough for the oil to flow freely at lowest probable temperature. On the other hand, the viscosity must be high enough so as to guarantee some lubricating value for the injection plungers and prevent leakage. In this connection, the lowest limit which should be set on a fuel is not less than 35 Saybolt sec at 100 F.

Viscosity also plays an important part in relation to atomization and penetration requirements of the combustion chamber. Thus a heavy fuel will usually penetrate deeper into the high-pressure air in the compression chamber than will a light fuel. This results from the fact that a heavy oil tends to maintain a more or less solid stream as it travels through the compressed air. A light fuel, on the other hand, tends to spread over a wide area through the combustion air and does not penetrate far enough for complete combustion. The ideal fuel presents a compromise between penetration and fogging or spreading. From this standpoint, the engine builder's recommendation represents the most reliable guide to fuel selection.

Fig. 1—This piston from a laboratory test engine operated at constant full load for 108 hours with the wrong lubricating oil. Note the hard lacquer-like deposits around the top rings and the darkened piston skirt, which also gives evidence of blowby. Freedom from deposits around the oil ring shows the effect of temperature

Ignition characteristics of different fuels vary greatly. Ignition quality is the ability to ignite spontaneously under the conditions existing in the engine cylinder. A fuel with good ignition quality, that is, one that will auto-ignite at low temperatures, is most desirable for diesel engines, for several reasons. Ease of starting, smoking, and knocking all relate to a fuel's ignition quality. This obviously important property is usually measured in terms of the "cetane number." Let's see exactly what this term means and how it is measured.

As is well known, crude oil is one of the thousands of combinations formed by hydrogen and carbon. The hydrocarbon family ranges from such a simple combination as the gas methane (one hydrogen atom and four carbon atoms) to the liquid fractions which comprise fuels and lubricants and to the semi-solid and solid compounds which comprise waxes and asphaltic materials. Through this progression from gas, to

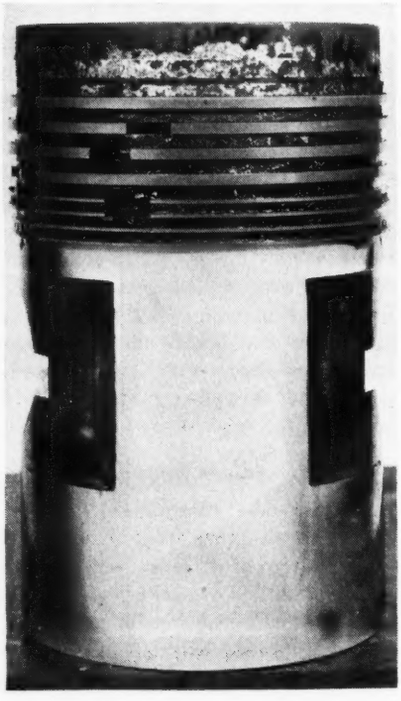


Fig. 2—This piston, also taken from a laboratory test engine, operated at full load for 1000 hours. Note that all rings are free in their grooves and bear out against the cylinder wall as shown by the clean, shiny appearance of the ring

liquid, to solid compounds, the number of atoms of hydrogen and carbon increases, the molecular weight also increases, and the chemical and physical properties change. One of these hydrocarbon families, having the chemical formula $C_{16}H_{34}$, is given the name "cetane."

Cetane in its purest form makes an excellent diesel fuel but it is commercially impractical to separate completely the cetane family from other hydrocarbon families having similar boiling points. Cetane content also varies widely from one crude to another. Another hydrocarbon family, named alpha-methyl-naphthalene, $C_{10}H_7CH_3$, having a similar boiling point to cetane, displays exceedingly poor ignition characteristics in diesels. The proposed ASTM yardstick for measuring ignition quality of diesel fuel, called the "cetane-number" scale, depends on the proportions of these two hydrocarbon families.

The Cetane Scale

On this standard scale, cetane is 100 and alpha-methyl-naphthalene is zero. Thus a "cetane number" of 100 means an ignition quality equal to that of pure cetane, while a cetane number of 0 indicates an ignition quality equal to that of alpha-methyl-naphthalene. How about a number between? Well, a cetane number of 60 indicates an ignition quality equal to that of a mixture of 60% cetane and 40% alpha-methyl-naphthalene. In other words, ignition quality of a fuel to be tested is compared to ignition qualities of standard mixtures of these two hydrocarbons. Although research workers have proposed several methods for measuring ignition quality on this cetane scale, the ignition-delay method, using a single-cylinder test engine, is widely employed.

On the test engine, a mechanism varies the compression ratio while other operating conditions are held constant. An electrical contact on the injection plunger measures the beginning of the "ignition-delay" period. When ignition of the fuel charge occurs, a diaphragm in the combustion chamber makes another contact. This gives time elapsing from injection to beginning of ignition, or "ignition-delay" period.

To determine the cetane number, the fuel to be tested is supplied to the engine and the compression ratio is varied until the ignition-delay period reaches a standard length. It can be seen that fuels of poor ignition quality require a high compression ratio to shorten the delay period to the standard length while fuels of good quality display shorter delay periods and so require lower compression ratios to obtain the standard delay. After finding and recording the compression ratio for the test fuel, the operator runs various mixtures of cetane and alpha-methyl-naphthalene in the test engine, finding and recording the compression ratio required in each case to bring the delay period to the standard figure. The cetane number of the test fuel equals the percentage of cetane in the mixture that requires the same compression ratio as the test fuel to produce the standard delay period.

The foregoing indicates that if an operator expects peak performance from his diesel, coupled with freedom from combustion difficulties, he must purchase fuels of good cetane rating.

Proper storage and handling of fuels cannot be over-emphasized. Numerous tests reveal that when galvanized tanks are used, minute particles of zinc and iron flake from the sides of the tank and contaminate the diesel oil, causing severe wear of injection plungers, upper cylinder walls, pistons, and piston rings. Welded tanks of non-corrosive materials, such as copper-bearing steel, give best service. Preferably, tanks should be installed above ground, on a substantial foundation, with a slope of not less than ½ in. per ft of length and with the outlet 2¾ in. above the bottom. This arrangement insures that clean fuel will be drawn out while water, dirt, sediment, etc, sink to the bottom.

Diesel engine builders and oil companies have carried on intensive research during the past few years to learn more about the performance characteristics of various types of lubricating oils. Newly developed chemical addition agents have, in some cases, demonstrated their worth in retarding piston-ring deposits and improving the mineral oil's stability and "oiliness" characteristics. To date, no one compound or combination of compounds will give an oil all of the properties desirable in a perfect lubricant. In some engines a straight mineral oil, properly refined and properly selected, gives best results. Other engines, principally the smaller, high-speed types which employ precombustion chambers and which are sensitive to carbon formation, require special types of mineral oils with chemical addition agents.

However, intensive laboratory research and wide field experience proves one point conclusively. The diesel operator who attempts to purchase lubricants on the basis of physical specifications follows a dangerous policy, one which does not have a sufficient basis in fact. Recent changes in refinery technique greatly alter performance characteristics of the finished oils. In times past, when lubricants were refined from only a few different types of crudes, by more or less conventional refining methods, the yardstick of oil specifications may have been a reasonably accurate guide to performance

TABLE I—ASTM DIESEL-FUEL-OIL CLASSIFICATION

Grade of Fuel	*1-D*	*3-D*	*4-D*	*5-D*	*6-D*
Saybolt Universal Viscosity, at 100 F min	35	35	—	—	—
Saybolt Universal Viscosity, at 100 F max	50	70	250	—	—
Saybolt Furol Viscosity, at 122 F max	—	—	—	100	300
Pour point, F max	35	35	35	—	—
Cetane number	45	35	30	—	—
Diesel index*	45	30	20	—	—
Flash point, F min	115	150	150	150	150
Carbon residue, % by vol, max	0.2	0.5	3.0	6.0	—
Ash, % by weight, max	0.02	0.02	0.04	0.08	—
Sulphur, % by weight, max	1.5	1.5	2.0	2.0	2.0
Water and sediment, % by vol	0.05	0.1	0.6	1.0	—

$$*\textit{Diesel Index} = \frac{\textit{Aniline point, F} \times \textit{API Gravity}}{100}$$

Aniline point is found by heating equal volumes of aniline and fuel oil in a jacketed test tube until a clear solution is obtained, and then noting the temperature at which turbidity appears on cooling.

ASTM DIESEL-FUEL RECOMMENDATIONS

Grade	*Type of Engine*
1-D	Solid-injection engines operating at more than 1000 rpm
3-D	Solid-injection engines operating at from 360 to 1000 rpm
4-D	Air-injection engines operating at less than 400 rpm; solid-injection engines with cylinder dia over 16 in., operating at less than 240 rpm
5-D	Air-injection engines operating at less than 240 rpm
6-D	Used only in isolated instances

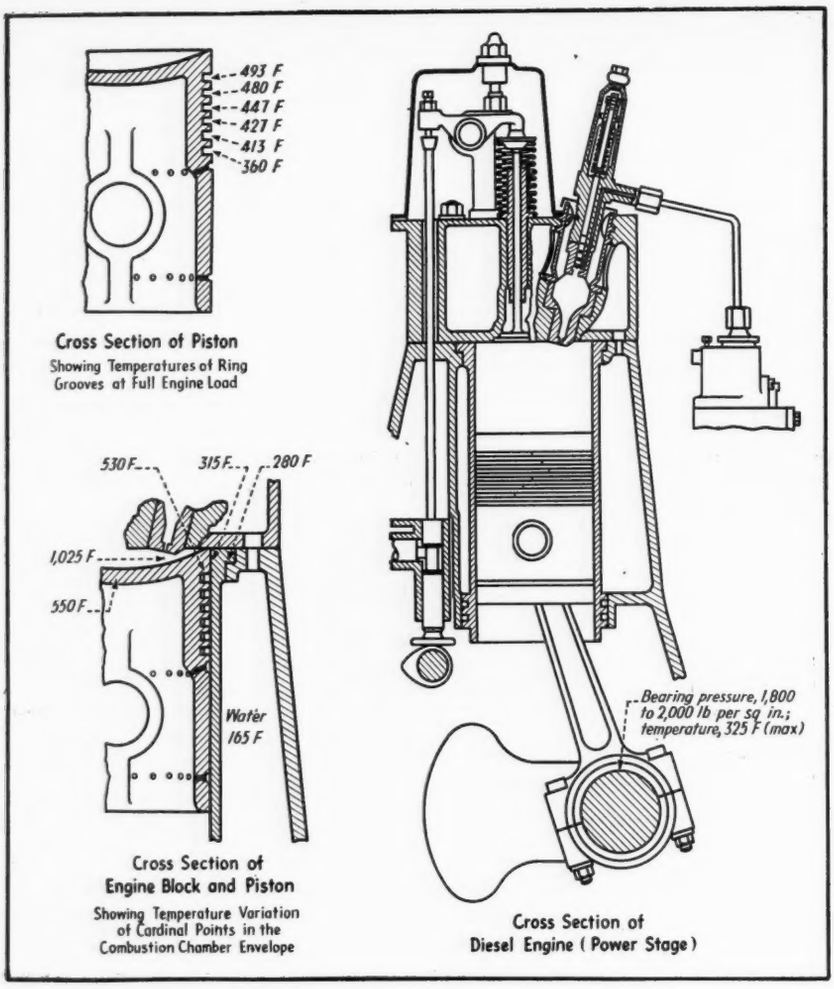

493 F
480 F
447 F
427 F
413 F
360 F
Cross Section of Piston
Showing Temperatures of Ring Grooves at Full Engine Load
530 F
315 F
280 F
1,025 F
550 F
Water 165 F
Cross Section of Engine Block and Piston
Showing Temperature Variation of Cardinal Points in the Combustion Chamber Envelope
Bearing pressure, 1,800 to 2,000 lb per sq in.; temperature, 325 F (max)
Cross Section of Diesel Engine (Power Stage)

Fig. 3—Engine cross-section shows temperatures at important points

characteristics. This situation no longer holds. Sources of crude oil vary widely and the advent of solvent refining has completely revolutionized any slight relation that physical characteristics may once have had to an oil's service performance.

As an illustration of this point, consider the piston shown in Fig. 1. This was taken from a laboratory test engine in which a lubricating oil of exceptionally high physical specifications (gravity, flash and fire points, neutralization number, and carbon content) was used. The 1-cylinder test engine, operating at constant full load, failed after 108 hours, due to excessive blowby. Study of the picture reveals that all top piston rings are stuck in their grooves by a lacquer-like deposit.

The piston shown in Fig. 2 operated under identical conditions of service for 1000 hours. All rings remain clean and free in the grooves and the shiny appearance of the ring surfaces indicates that they have been bearing out against the cylinder wall. Physical specifications of the lubricant used in the second case were considerably lower (when judged by the standards of the average operator who cannot be expected to be thoroughly informed on all the technicalities of lubricating-oil refining, composition and selection).

Thus it may be said that the first requisite of a suitable diesel lubricant should be its ability to burn clean in the cylinders and that when exposed to pressure, temperature, and destructive effects of the byproducts of combustion its chemical composition should not change so as to make it responsible for excessive deposits in or around the piston rings, or through the combustion chamber.

Some types of lubricating oils, particularly those recognized as outstanding in the automotive field, do not fit diesel service because of their tendency to throw down hard lacquer-like carbon deposits within a critical range of temperature. Small, high-speed, mobile-type diesels are more difficult to lubricate from the standpoint of ring sticking than larger, slower-speed stationary engines. Fig. 3 lists temperatures existing at various points of the combustion-chamber envelope of a pre-combustion-chamber engine. Fig. 4 shows the critical temperature range (470 F to 570 F) in which one particular lubricating oil tested had a tendency to throw down excessive amounts of carbon. The temperature of the upper piston rings of the engine illustrated in Fig. 3 falls right into this range. Obviously to secure satisfactory performance from the standpoint of minimizing ring deposits in this temperature range, it is necessary to use another lubricant which does not reach a peak of carbon formation within the critical temperatures at which the piston rings operate.

Ring Sticking

We can study ring sticking more accurately by dividing the contributing causes into two separate classes, see Fig. 5. On the left side, we see a hard lacquer-like deposit formed when decomposition of the lubricating oil begins. This hard film is formed when the piston is hot. Upon shutting down, aluminum pistons radiate their heat quickly and inasmuch as clearance in the ring grooves is small, the vertical contraction in the groove, which amounts to less than 0.001 in., will tend to seize the lacquer film and clasp the ring in its groove. This clamping does not necessarily take place over the entire ring surface, but may be localized

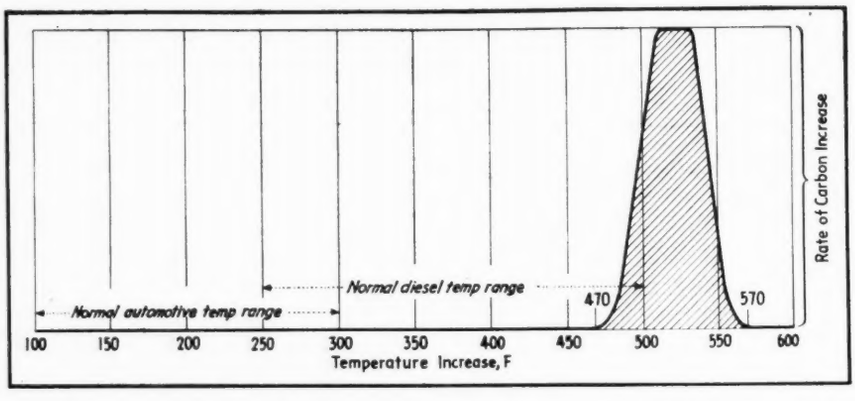


Fig. 4—Theoretical critical temperature of carbon formation for a chemically unsuitable type of lubricating oil

in limited regions only. Following this action, radial contraction of the piston continues and in the case of a piston 5¾ in. in diameter, the contraction may amount to as much as 0.020 in. Thus the ring is drawn away from the cylinder wall and the gap formed by this action makes it impossible for the ring to follow the contour of the cylinder liner, and blowby results. The hot gases of compression and combustion sweep the lubricating oil film from the cylinder wall, producing loss of compression, abrasion, high localized temperatures, rapid wear, and, in severe cases, piston seizure.

Carbon Formation

The right side of Fig. 5 illustrates another type of ring sticking. In this case, hard granular carbon begins to form at the back corner of the top ring and accumulates between the ring and the piston contour. As carbon continues to form in this area it is packed in back of the ring by its reciprocating motion as it works in and out, following the cylinder wall. The ring soon becomes completely restricted in its movement and rides constantly against the liner. This means that there can be no flexible flow of the ring surface with the contour of the cylinder wall and there is great danger of rupture of the oil film.

Experience in the lubrication of precombustion-chamber diesels and other designs more sensitive to carbon formation has seemed to favor the naphthenic type of lubricating oil, up to the present. However, recent developments have brought to light outstanding addition agents for correctly refined paraffinic lubricating oils, making this class highly suitable for diesel lubrication. In addition to preventing the formation of hard, lacquer-like, carbonaceous deposits in the combustion chamber and around the upper piston rings, these addition agents in correctly refined paraffinic oils increase the film-strength characteristics and inhibit oxidation in the crankcase.

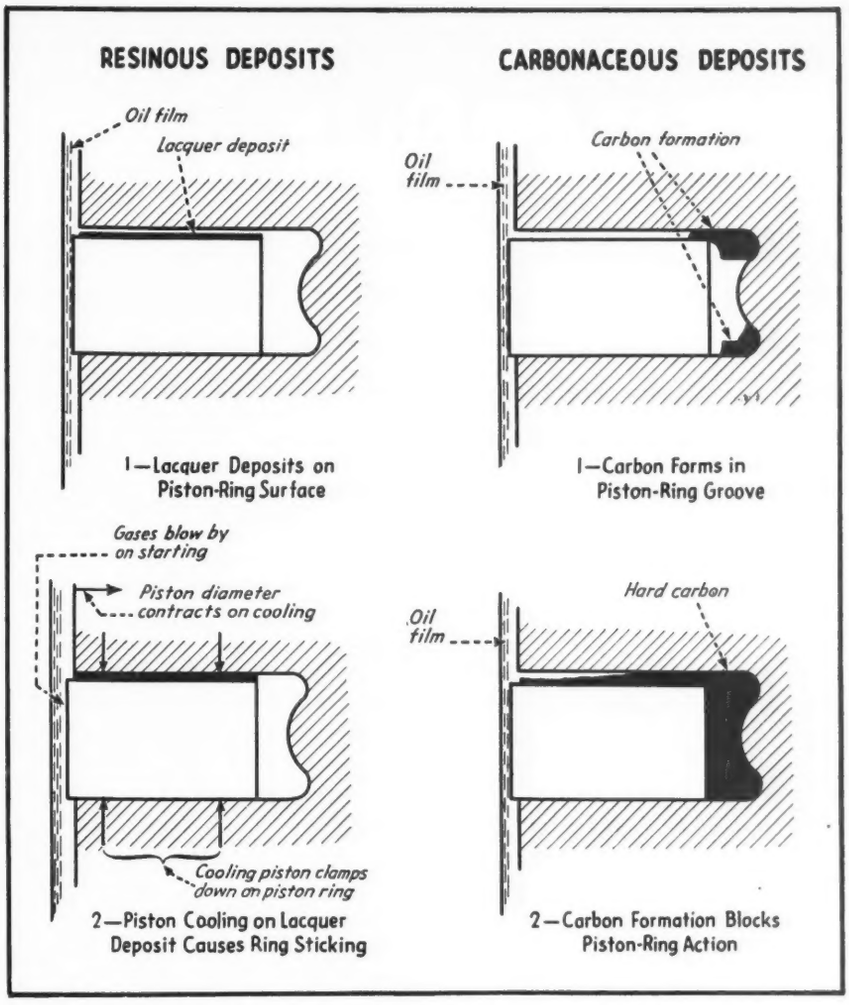


Fig. 5—How resinous and carbonaceous deposits produce ring sticking

TABLE II

Pumpability of Diesel Fuels

Low Temperature Limit for Satisfactory Handling	*Approximate Viscosity, Saybolt sec at 100 F*
— 20 F	42
0	50
20	65
40	98
60	160

(Paraffinic Type)

Pour Point	*Low Temperature Limit for Satisfactory Handling*	*Approximate Viscosity, Saybolt sec at 100 F*
— 30 F	— 20 F	32
0	10	38
30	40	42

(Naphthenic Type)

Engineers who desire to operate their plants at the lowest possible cost should carefully consider the chemical stability of the crankcase oil. The oil should resist to the highest degree the effect of oxidation. Oxidation is responsible for the formation of organic acids in the oil, which, if allowed to become sufficiently concentrated, may be the cause of bearing corrosion and failure. In addition, if the lubricating oil is not highly chemically stable, excessive amounts of sludge form, which accumulate throughout the drilled passages of the crankshaft, connecting rods, and circulatory system. Such sticky sludges also have a tendency to accumulate over oil screens and on oil cooler surfaces, a threat to the entire engine.

In summarizing these remarks about lubricating oil, it cannot be too strongly emphasized that an oil's performance, both in the cylinders and in the crankcase, is related to its chemical characteristics. Since oil is a complex chemical compound, no laboratory can predict its actual performance value in an engine, based on laboratory evaluation alone. The only actual proof of a lubricating oil's suitability for diesel-engine service lies in knowledge of what the oil will actually do in such an engine. The wise operator will be guided by the experience of reputable companies who have a sufficiently large staff or lubricating engineers in the field to study constantly performance characteristics of various types of lubricants, and laboratory and refinery technicians to coordinate this data.

Viscosity constitutes the one important physical characteristic of a lubricating oil for diesel service (we have given oil stability from the standpoint of resistance to ring sticking and crankcase deposits first consideration, because this chemical stability is so exceptionally important in keeping down maintenance cost). The operator can look to the engine builder as the most reliable authority for the proper viscosity of oil.

ASME Talks Shop

Mechanical engineers at semi-annual meeting, Milwaukee, Wis., really get down to brass tacks of steam-plant operation. Bread-and-butter papers, condensed here that those who run may read, give valuable information on construction, performance and blading of turbines, metals for high-temperature service, and heat insulation of piping

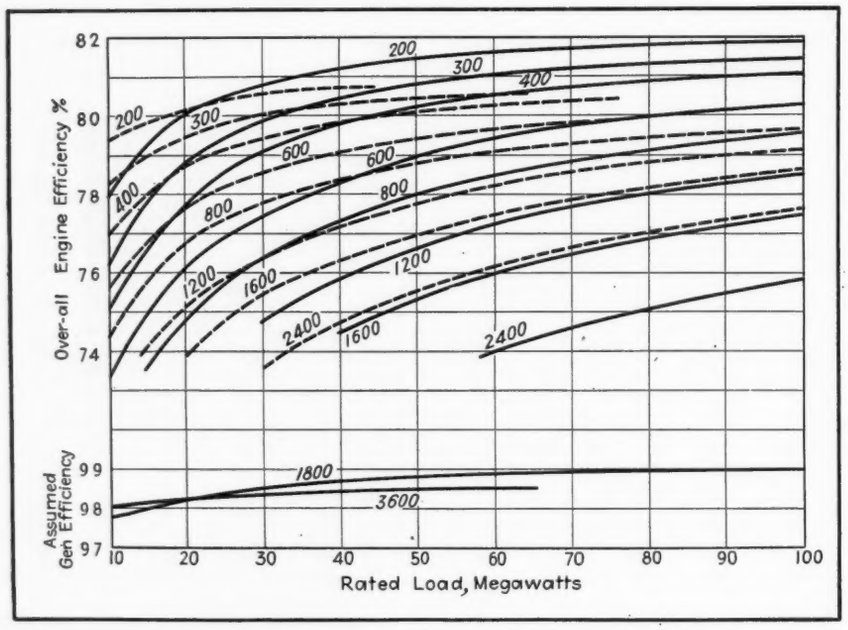


Fig. 1—Over-all engine efficiencies of standard G E condensing turbines, 10,000 to 100,000 kw, both 1800- and 3600-rpm types, over a pressure range from 200 to 2400 lb

▶ TWENTY YEARS ACCUMULATION of test data forms a background for "engine efficiency" calculations of large turbines presented by General Electric's turbine experts, G B Warren and P H Knowlton, at the semi-annual meeting of the ASME, Milwaukee, Wis., June 17-21.

Their methods, now available to operators and engineers for the first time in comprehensive form, permit making reasonably accurate computations of turbine performance at various steam pressures and temperatures without drawing on turbine manufacturers for preliminary proposal data. These independent calculations, made entirely by the prospective purchaser, allow first-hand estimation of the effect of alternate schemes and should result in much better understanding of the quantitative effect of changing steam conditions and a considerable saving in time required for such preliminary studies.

Fig. 1 shows over-all engine efficiencies of standard GE turbines, 10,000 to 100,000 kw, both 1800- and 3600-rpm types, over a pressure range from 200 to 2400 lb. These quantities, used in conjunction with theoretical steam-rate tables available in book form*, yield turbine water-rate for any steam conditions if correction factors of Fig. 2 are considered. Engine efficiency curves are plotted for standard conditions of 300-F superheat, 4% exhaust loss, 1.25% mechanical loss and generator efficiency (hydrogen cooling) as shown. Water rates obtained are, of course, for non-extraction performance; bleed performance requires additional computations also described.

Exhaust loss can be calculated from the curves of Fig. 3 if the exhaust annulus area and equivalent annulus velocity are known or can be computed. Extraction for feedwater heating has the effect of reducing the exhaust flow which in turn usually reduces the exhaust loss at a given load. If flow to condenser is reduced 15%, the percent exhaust loss would usually be only about 62% of that non-extracting.

Vacuum correction, accurate enough for most comparisons, can be calculated by the curves shown on POWER Data Sheet No. 97, page 126 of this issue, which takes account of both the changes in exhaust loss and available energy. Values are an average of tests on several machines 10,000 kw and larger.

Exhaust losses for backpressure turbines are, of course, much smaller. Complete data on efficiency, partial load correction factor and exhaust loss are given in the paper and examples worked out numerically.

Preformed Pipe Insulation

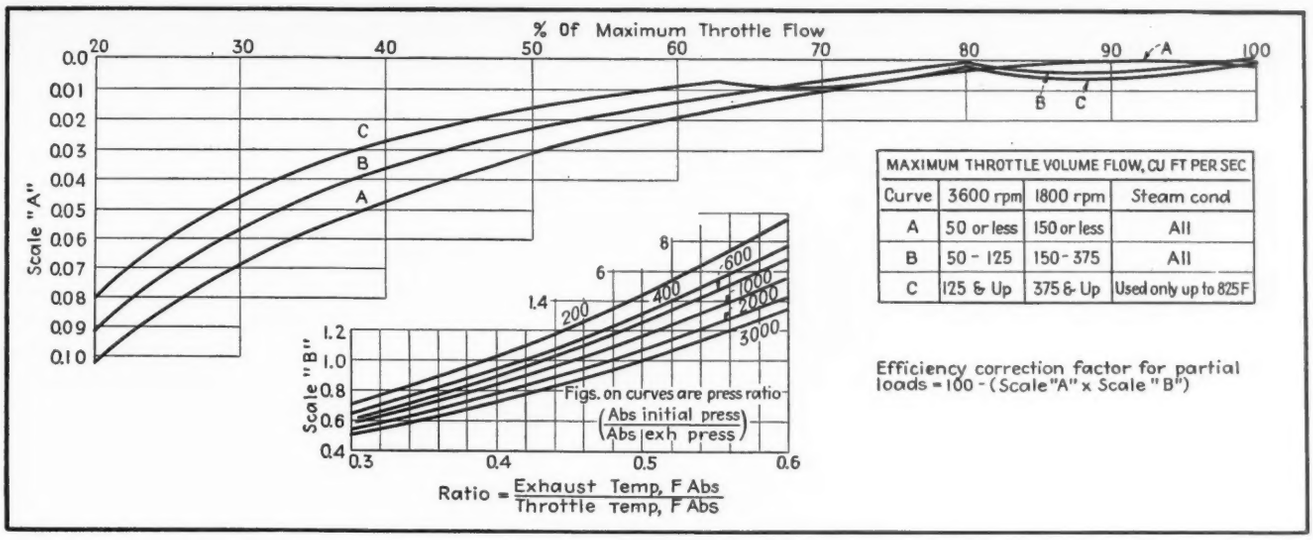
Certain new practices of The Detroit Edison Co in insulating piping, ducts, furnace walls and turbines were discussed by E T Cope and W F Kinney. Continued rise in cost of construction labor has led to some departure from long-accepted pipe-covering practice. However, while some definite solutions have been reached, others are still under investigation and additional problems have been recognized only recently.

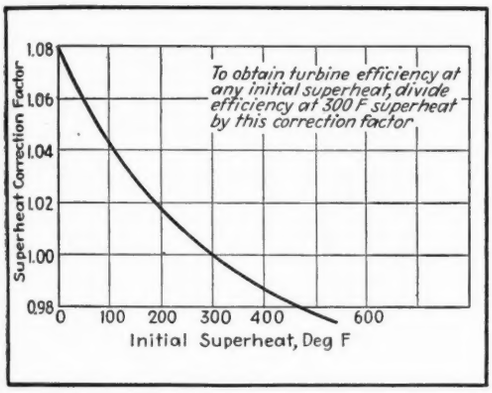
Hot-air ducts and flues tend to warp and move to a certain extent, affecting tightness of insulation. Often burnt canvas and cracking occur. One design, quite successful but fairly expensive, wired blocks onto a grill of reinforcing rods held in position by threaded steel nuts welded to the casing.

Sectional covering for high-temperature piping over 8-in. was compared with the usual practice of wiring-on flat blocks. Best results were obtained by stapling together three adjacent 3-ft sections and covering with canvas to provide a continuous run of 9 ft of pipe covering. Joints between these 9-ft sections were allowed to open when the pipe was heated in service, then packed with resilient curly glass wool. Covered with a light-gage metal band, movement of these expansion bands is permitted and the painted ensemble is neat, durable and economical. Construction is shown in Fig. 4.

The second stage of the Detroit Edison program consisted of securing several single-layer sectional coverings of high- and low-temperature material

* "Theoretical Steam-Rate Tables", by J H Keenan and F G Keyes, ASME, 1938.


% Of Maximum Throttle Flow
Scale "A"
Scale "B"
Figs. on curves are press ratio
(Abs initial press / Abs exh press)
Ratio = Exhaust Temp, F Abs / Throttle Temp, F Abs
A
B
C
MAXIMUM THROTTLE VOLUME FLOW, CU FT PER SEC
Curve | 3600 rpm | 1800 rpm | Steam cond
A | 50 or less | 150 or less | All
B | 50 - 125 | 150 - 375 | All
C | 125 & Up | 375 & Up | Used only up to 825 F
Efficiency correction factor for partial loads = 100 - (Scale "A" x Scale "B")


Superheat Correction Factor
To obtain turbine efficiency at any initial superheat, divide efficiency at 300 F superheat by this correction factor
Initial Superheat, Deg F

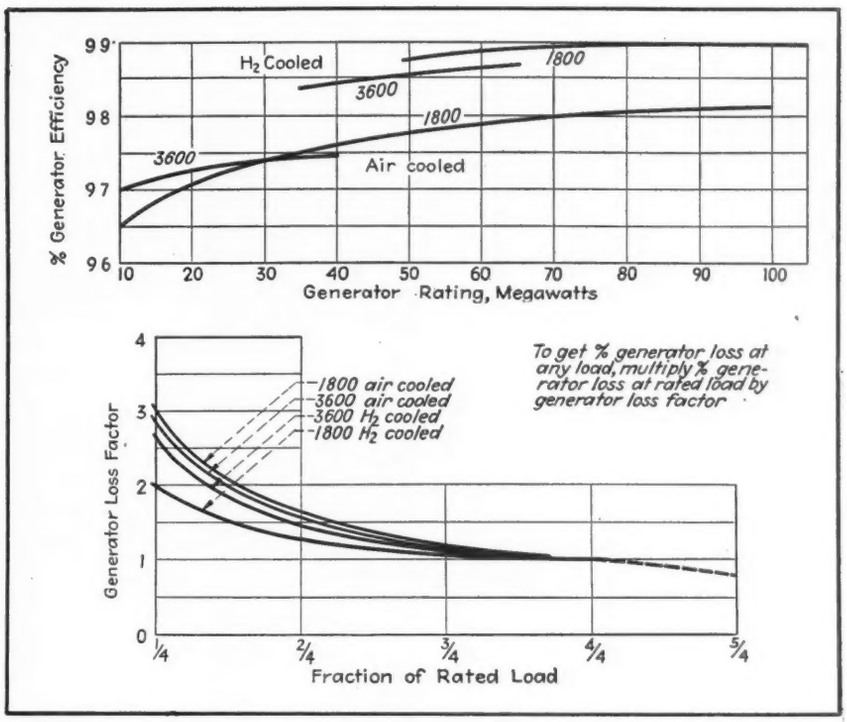
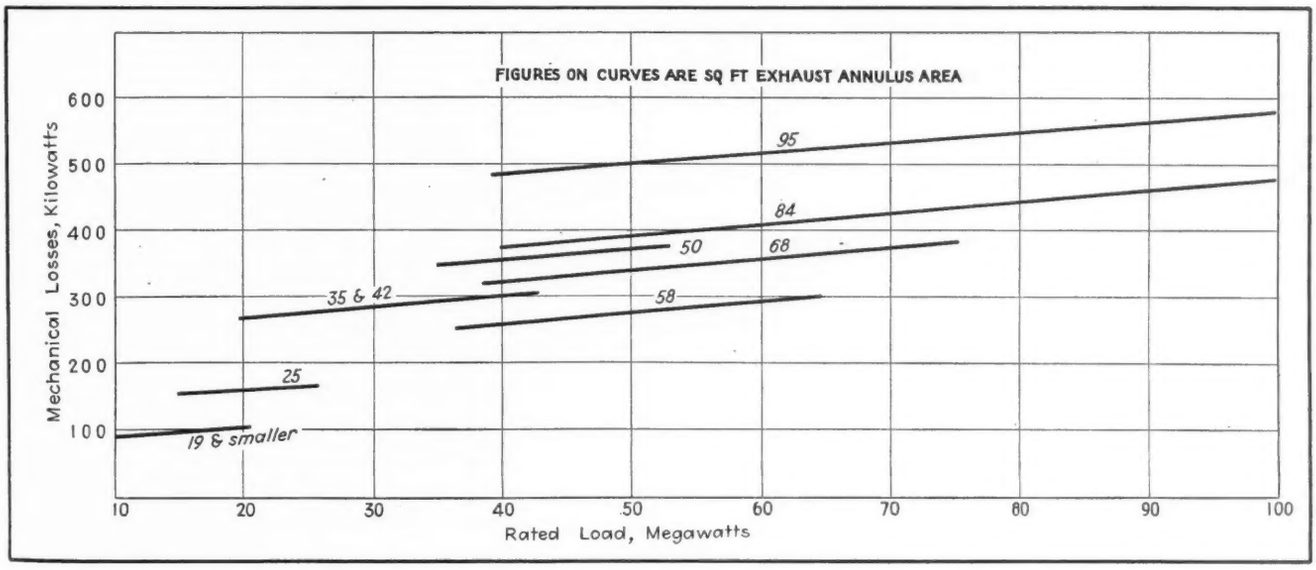
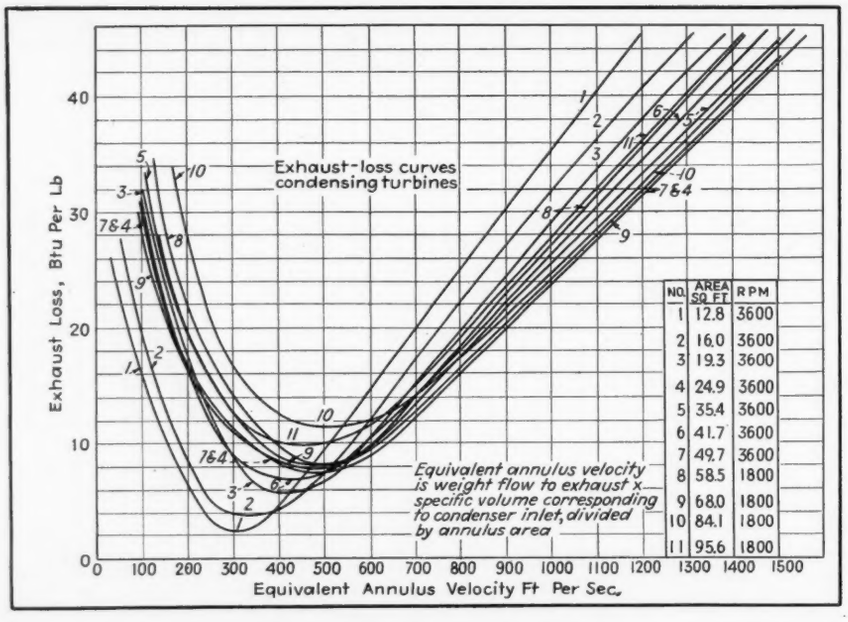


Fig. 2—(Top) Efficiency correction factor for partial loads, to be applied to engine efficiencies of Fig. 1. (Above, left) Amount of superheat also affects blade efficiency. (Right) Generator efficiency for air and hydrogen cooling with correction for partial loads. (Below) Mechanical losses for different-size exhaust areas




Exhaust-loss curves condensing turbines
Exhaust Loss, Btu Per Lb
Equivalent Annulus Velocity Ft Per Sec.
Equivalent annulus velocity is weight flow to exhaust x specific volume corresponding to condenser inlet, divided by annulus area
NO. | AREA SQ FT | RPM
1 | 12.8 | 3600
2 | 16.0 | 3600
3 | 19.3 | 3600
4 | 24.9 | 3600
5 | 35.4 | 3600
6 | 41.7 | 3600
7 | 49.7 | 3600
8 | 58.5 | 1800
9 | 68.0 | 1800
10 | 84.1 | 1800
11 | 95.6 | 1800

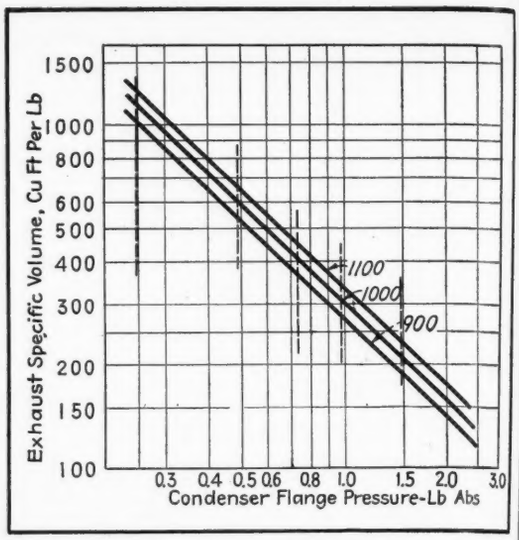


Fig. 3—Exhaust-loss curves for condensing turbines and specific volume relation for calculating velocities

Cylinder of an axial compressor for use with gas turbine interests G L Kohlberg (left), Allis-Chalmers, Bruno Nordberg (center), diesel builder, and W C Lindemann, of Lindemann and Hoverson

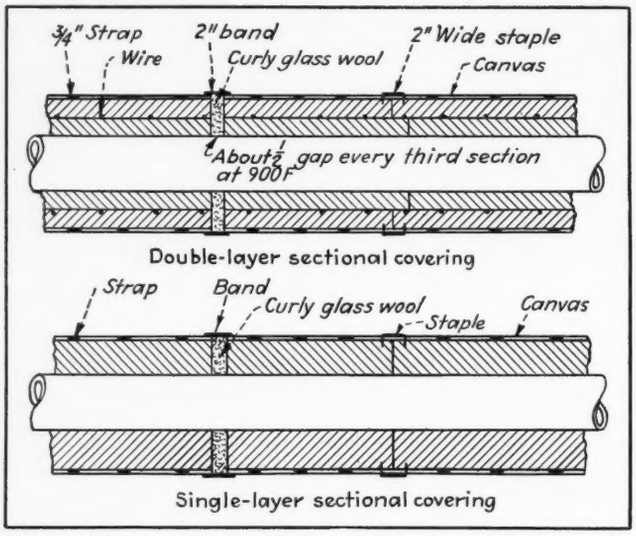


Fig. 4—Assembly of sectional insulation for large high-temperature pipes, developed by The Detroit Edison Co

combined. With either covering, the nuisance of cracked canvas was practically eliminated. Tests showed that hot spots did not result from the butt joints in the insulations.

For low-temperature piping (below 50 F), the importance of preventing entrance of moisture is well recognized. Isolation of the vulnerable points, such as valves and fittings, by a vapor barrier is usual. Sealing, however, has recently been accomplished at less cost by putting a self-vulcanizing latex emulsion on cotton sheeting. Evidence was presented that even two coats of paint applied to canvas covers do not give a vapor-tight seal.

For insulation of turbine barrels before installation of planished casings, turbine pads composed of a textile jacket enclosing a loose filler appear to be most desirable. For high temperature a glass fabric pad with glass-wool filler is preferred, although reinforced white asbestos pads with mineral-wool or amosite-asbestos filler are used.

Other papers included a report on design of steam-turbine blading, by R C Allen, Allis-Chalmers Mfg Co; a description of fatigue-testing procedure for turbine blades, by R P Kroon, Westinghouse Electric & Mfg Co; and a comprehensive review of turbine design, by G B Warren, General Electric.

An inspection trip through humming Allis-Chalmers shops emphasized the almost universal use of welding from 30-ft diameter heavy-wall hydro-turbine scrolls to a midget electronic set for welding small turbine blades into shroud bands. One of the gas-turbine sets for oil-refinery service was in operation on the test block and unassembled parts of other units offered opportunity for a study of construction details.

Coal Handling at Chicago's Sewage-Treatment Works

Fig. 1—General view of boiler plant (four 110,000- lb-per-hr, 425-lb units) and its coal-handling system

A system consisting of an apron conveyor, two bucket elevators, a belt conveyor, dragline scraper and crusher, unloads, crushes and stores 100 tons per hour

By W G HUDSON
Engineer, Link-Belt Co

▶ STEAM FOR CHICAGO'S new 20-million-dollar sewage plant is supplied by four boilers, each rated 110,000 lb per hr at 425 lb g pressure. These boilers are equipped to burn either sewage, sludge or coal. As there is a ready market for the sludge as fertilizer, the boilers are fired with coal. To handle this coal requires an extensive system, one of the features of the plant.

Equipment Layout

Fig. 1 shows a general view of the plant. The monitor section below the twin striped stacks houses the coal-storage bunker. A belt conveyor extends from the far end of the bunker on the left out and across the gallery to the vertical concrete structure on the right, which contains two bucket elevators and the flyash storage. Just to the right of the elevator-tower base is a brick structure that houses two railway tracks, one for loaded coal cars over a track hopper and the other for chemical tank cars.

The usual arrangement of the coal-handling system would be to extend the belt conveyor from above the bunker downward at 18 or 20 deg to a point beneath the track-hopper, thus eliminating the elevators. The lift, however, is 105 ft, which would locate the track hopper about 225 ft farther away from the end wall of the boiler house. This would seriously restrict the area for ground coal storage. It would also involve other provisions for supporting the pneumatic flyash conveyor and require another unit to form the initial coal pile from which the drag scraper functions in stocking out. Architecturally, the adopted layout gives a pleasing appearance.

Incoming coal passes from car to bunkers or to reserve storage at a rate of 100 tons per hour. Loaded cars are pulled into position by an electric car spotter. A track hopper 34 ft long by 14 ft wide permits discharge from drop-door gondola at a single spotting. A track hopper of this length and width, if tapered to a single outlet, would require an excessive pit depth. Two outlets are therefore provided, each with a reciprocating feeder discharging to a common point on the apron conveyor beneath, Fig. 2. These feeders are inter-connected and driven by a 7.5-hp motor at 20 strokes per minute, giving a combined flow of 100 tons per hr. Length of stroke of the feeder plates, actuated by a variable-throw eccentric, determines the feed rate. After the stroke length is regulated no further adjustment is required.

Removing Tramp Iron

From the feeders the coal moves as a thin ribbon on a 42-in. x 35-ft steel apron conveyor, driven by a 5-hp motor at 20 ft per min. A magnetic drum mounted on the head shaft between the sprockets strongly magnetizes the overlapping steel pans as they pass over the head. Fragments of iron adhere and are carried back several feet along the return run, then drop to the floor between stationary non-magnetic manganese-steel skirt boards.

The apron conveyor discharges to a 100-ton-per-hr hammer-mill crusher, when reducing run-of-mine coal to ¾-in. ring size. A 12-in. grid across

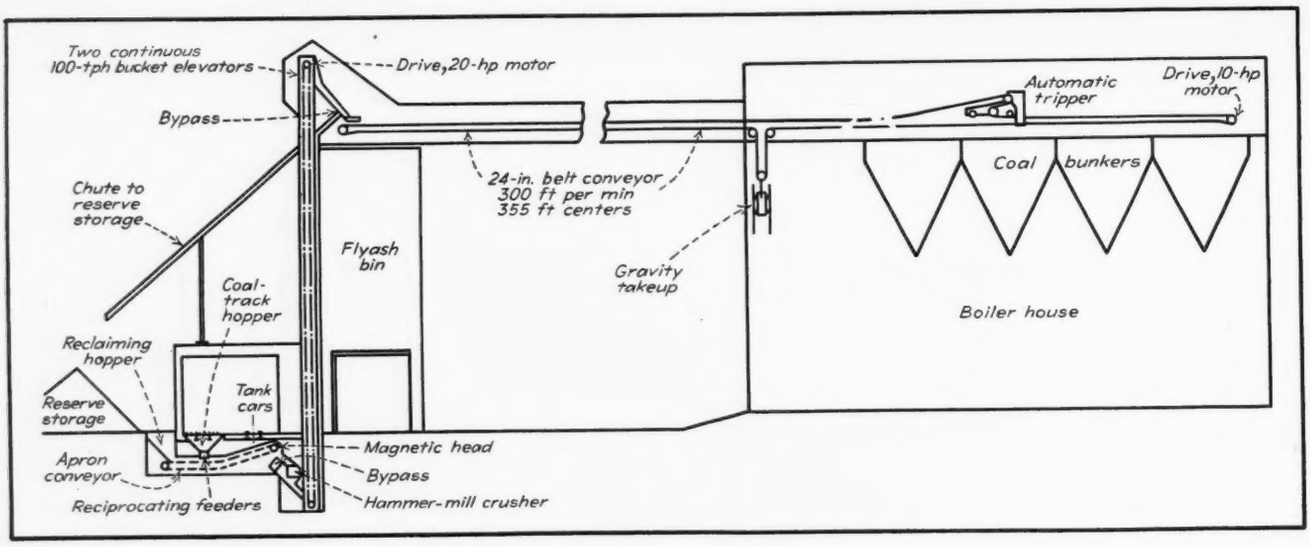


Fig. 2—General arrangement of coal-handling system

the track hopper limits the lump size. The hammer mill is driven by a 50-hp motor. Frequently coal shipments can be obtained which do not need to pass through the crusher. A bypass permits direct discharge from apron conveyor to either of the two elevators, one serving as a standby.

Coal Elevators

These elevators are of exceptionally rugged, slow-speed design, operating on 113-ft vertical centers. They are continuous-bucket type, receiving their load after passing the foot wheels in a so-called loading leg. The buckets are carried between two strands of heavy-bushed steel-roller chain at 75 ft per min, and discharge over the head wheels to the belt conveyor, or through a bypass chute to the initial pile for the drag scraper. This chute is seen extending to the right out over the car buildings, Fig. 1. Each elevator is driven by a 20-hp, explosion-proof, 1750-rpm motor connected by a 74 to 1 herringbone-gear speed reducer and heavy-roller-chain drive to the head shaft. An advantage of the chain drive is that a change in elevator speed may be made by a simple change of sprocket rather than by an expensive change within the herringbone reducer. An automatic brake prevents reversal of the elevator should power fail to its motor.

The horizontal belt conveyor with a 24-in. belt operates on a 355-ft center distance at 300 ft per min and is driven by a 10-hp motor through a herringbone-gear speed reducer and roller chain, Fig. 3. An automatic, self-propelling and self-reversing discharge tripper, Fig. 4, provides automatic distribution of coal along the entire length of the bunker. The belt pulley actuates two clutches geared by drive chain to the traction wheels on which the tripper is mounted. A lever, tripped by stops along the run, engages one or the other of two clutches and causes the tripper to travel slowly forward or backward a distance determined by the position of the stops. If the lever is set centrally by the attendant, both clutches are disengaged and the tripper remains stationary.

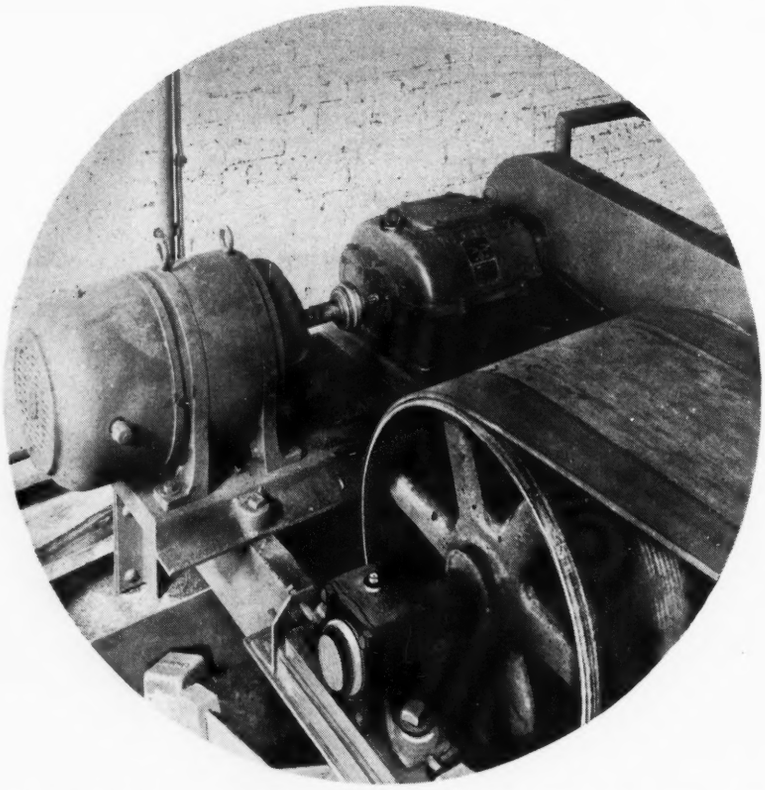


Fig. 3—Head end of 24-in. distributing belt conveyor driven by a 10-hp motor through a herringbone-gear speed reducer and a roller chain

Belt-conveyor carrying rolls, or idlers, are spaced on 5-ft centers. Every fourth idler is a self-aligning unit, which functions to centralize the belt and indicate need of roll adjustment. If one or more carrying rolls are not square with the belt it may travel off to one side, just as when a plank is rolled upon a diagonally placed roller. If the belt runs to one side or the other, the pivoted self-aligning unit is deflected by a slight pressure along the outer edge of the belt, which drifts back into line. This action is of course indicative rather than corrective since

it is not desirable to maintain constant pressure against the belt edge, as once was done by fixed side guide idlers. If one or more self aligners are observed to be functioning continuously, the intermediate idlers should be shifted slightly in a horizontal plane until the belt runs true. When such adjustments do not centralize the belt, other causes should be considered, such as a sluggish roll, bad alignment, off-central loading, etc. The return run of the belt is similarly equipped. All idlers have anti-friction bearings with the grease tubes led to one aisle for convenient lubrication.

Maintaining Belt Tension

A gravity take-up, about midway in the return run of the conveyor, holds the belt in constant tension. Maintaining tension by means of a weighted pulley hung in a bight of the belt has the advantage that the tension is constant regardless of belt stretch, or length variations due to climatic conditions.

In the discharge chute from the elevators to the belt conveyor, a flap gate diverts the coal through a chute to the 15,000-ton storage yard when desired. Coal bypassed from the elevators to a pile in front of a head post is spread over the storage area by a Sauerman power drag scraper. Essentially, this is a 2-cu-yd scraper hauled in either direction by a double-drum haulage machine geared to a 75-hp motor. Coal may be stocked out or reclaimed at 100 tons per hour with an average haul of 150 ft, or at reduced rates for longer haulages.

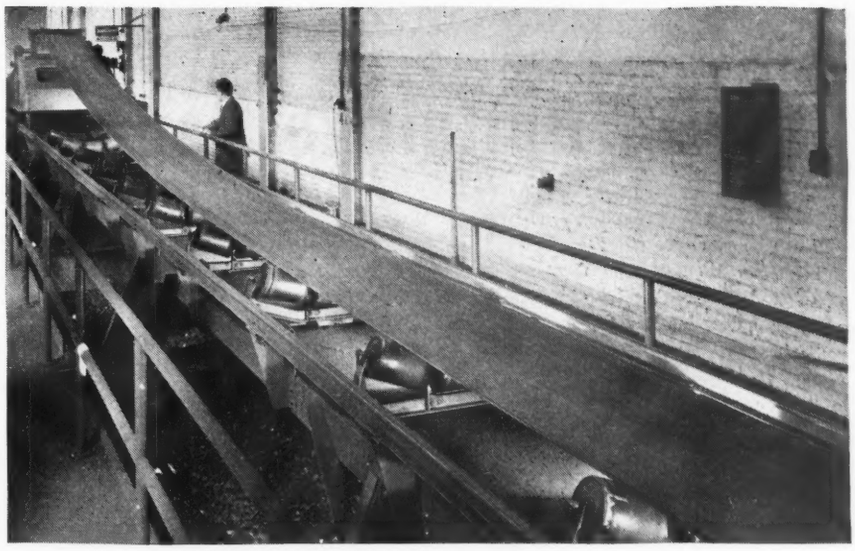
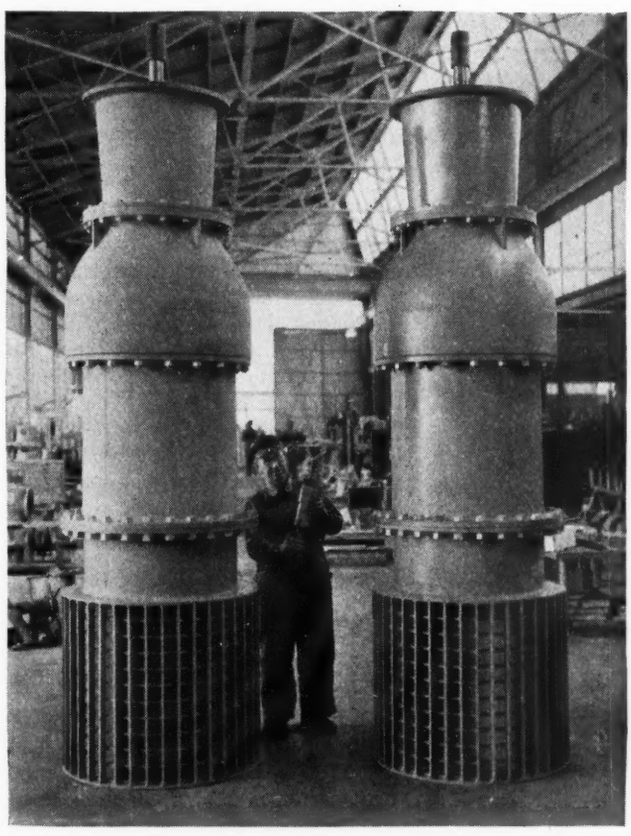


Fig. 4—Looking along the 24-in. belt conveyor toward the automatic tripper that distributes coal to the bunkers

The drums of the haulage machine are geared to provide a line speed of 300 ft per min for the loaded scraper, and 600 ft per min for the emptied scraper. The operator is stationed in a control house well above the structure which houses the haulage machine, where he has a clear view of the coal storage area at all times.

✦ ✦ ✦

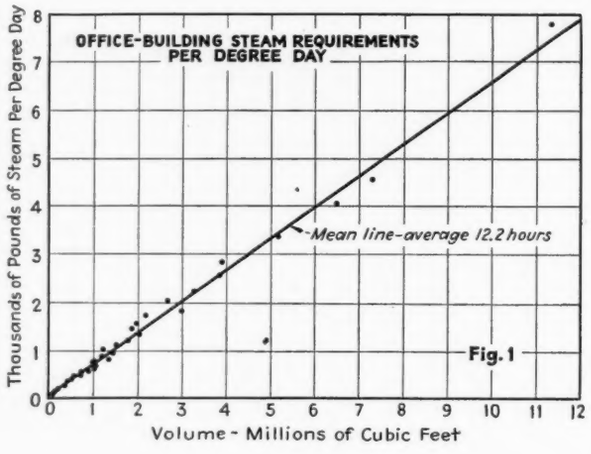


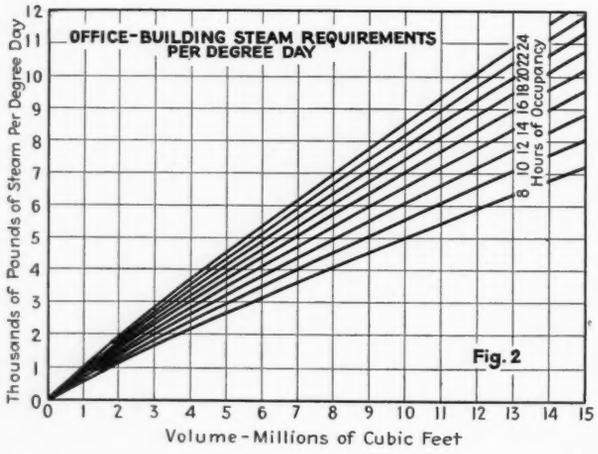
Canal Zone Gets Largest Turbine Pumps

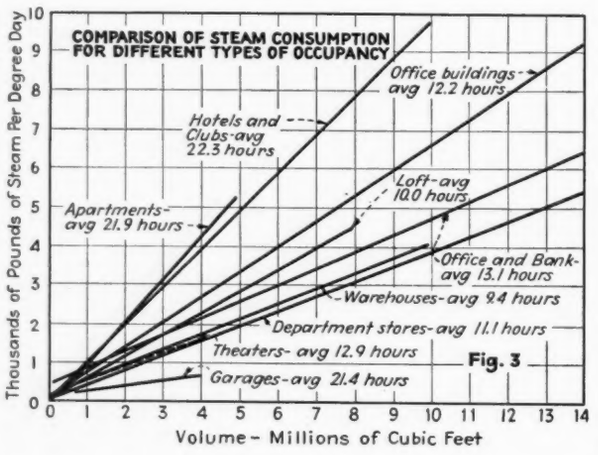
► In the Panama Canal Zone tropical rains cause temporary flooding of vital sites that must be dewatered quickly. For this purpose two of the largest vertical turbine pumps in the world have been built recently by the Peerless Pump Division of Food Machinery Corp for the United States Government. Weighing 60,000 lb each, exclusive of the motor, they have a discharge of 15,000 gpm (21,600,000 gpd) and are driven by 720-rpm, 250-hp motors. Their impeller bowls are 36 in. and pump columns 24 in. in diameter. They will be moved from place to place for pumping out caissons, sumps, concrete basins and for emergency service.

Because they will handle salt water at times, the pump columns are built of corrosion-resisting steel, with stainless-steel impeller shafts and special-bronze impellers. These pumps are provided with strainers of extra heavy construction built of welded-steel bars. The photo shows the pumps, without motors, supported on their strainers. For comparison, note the 4-in. pump held by the man. Additional turbine pumps have been ordered for emergency use to supplement these large units.

993 Buildings Report Steam Use


OFFICE-BUILDING STEAM REQUIREMENTS PER DEGREE DAY
Thousands of Pounds of Steam Per Degree Day
Mean line-average 12.2 hours
Fig. 1
Volume - Millions of Cubic Feet


OFFICE-BUILDING STEAM REQUIREMENTS PER DEGREE DAY
Thousands of Pounds of Steam Per Degree Day
8 10 12 14 16 18 20 22 24
Hours of Occupancy
Fig. 2
Volume - Millions of Cubic Feet


COMPARISON OF STEAM CONSUMPTION FOR DIFFERENT TYPES OF OCCUPANCY
Thousands of Pounds of Steam Per Degree Day
Office buildings - avg 12.2 hours
Hotels and Clubs-avg 22.3 hours
Loft-avg 10.0 hours
Apartments-avg 21.9 hours
Office and Bank-avg 13.1 hours
Warehouses-avg 9.4 hours
Department stores-avg 11.1 hours
Theaters-avg 12.9 hours
Garages-avg 21.4 hours
Fig. 3
Volume - Millions of Cubic Feet

Joint Committee of National Association of Building Owners and Managers and National District Heating Association completes comprehensive study of heating requirements. Data presented by Earle Shultz and J C Butler permits checking existing buildings or estimating for new construction

▶ FOR SEVERAL YEARS a study of standard quantities of steam necessary to heat buildings of various sizes and occupancy groups has been conducted by a Joint Committee. This year, for the first time, the large quantity of data collected permits dependable conclusions and accurate statistical analysis. Of considerable interest is the determination of a ratio of purchased steam for one large group of buildings to the equivalent Btu input in coal, oil, and gas for three other groups, all of sufficient number to warrant dependable results.

What Data Means

Data for 896 buildings buying steam are shown in Table I; corresponding information for 97 others generating their own steam is given in Table II. The effect of geographical location has been taken into account by dividing the total steam or heat use by the degree-days for each locality. A further calculation of lb or Btu per degree day per thousand cu ft of building volume is also indicated in the tables, although a

Fig. 1.—Steam use for 334 office buildings buying steam. Each point represents 10 buildings

Fig. 2—Effect of hours of normal occupancy on steam use of office buildings

Fig. 3—Steam requirement varies greatly with occupancy. Chart shows average periods during which heat is required each day

closer approximation to the effect of volume on steam consumption is given in the formulas of Table V.

The influence of hours of heating has been determined for each type of occupancy. The relation for office buildings is shown in Fig. 2.

Conclusions arrived at in this report are subject to a certain amount of error in estimating steam use for heating separately from that required for other purposes, in using slightly different methods of computing building volumes and in analyzing the element of personnel efficiency. These do not seriously impair the comparative relations between groups.

By comparing actual steam consumptions with the mean line, Fig. 1, amounts above or below average (mean line) represent the effect of type of heating system, type of control or operating efficiency. After eliminating groups of less than 20 buildings as an insufficient number for reliable analysis, the "lower half" of the office buildings purchasing steam were found to be 18% lower in steam consumption than the average, the "low quarter," 29%, and the "low eighth," 40%. This indicates that that important savings in steam consumption can be made by proper choice of type of heating system, kind of control and attention to efficiency of operating personnel.

Table III groups 334 office buildings purchasing steam according to type of heating system. Table IV shows the same buildings grouped according to type of control system. In each case the column titled "diversity factor" can be taken as a measure of the efficiency of the heating system and its control; the larger the diversity factor, the greater the steam consumption compared to

TABLE I—STEAM PURCHASED

Type of building	No. bldgs	Volume 1000 cu ft Total	Volume 1000 cu ft Average	Steam for Heating Total 1000 lb	Steam for Heating Lb/degree day	Steam for Heating Lb/deg-day 1000 cu ft	Average hours
Office	334	721,810	2,160	2,600,878	494,792	.685	12.1
Office and bank	49	146,878	3,000	452,708	84,945	.577	13.1
Office and printing	8	15,157	1,895	104,803	18,625	1.230	17.7
Office and theatre	7	34,652	4,950	80,953	14,314	.412	12.9
Office and stores or shops	26	41,996	1,615	132,390	25,917	.617	13.2
Bank	16	12,922	806	51,395	10,148	.786	11.7
Department store	63	214,182	3,400	430,517	82,472	.385	11.1
Stores	73	22,744	310	68,209	14,180	.624	10.4
Loft	63	54,586	865	152,583	32,096	.588	10.0
Warehouse	24	53,493	2,230	125,728	24,529	.459	9.4
Hotel and club	73	130,885	1,795	677,093	129,456	.990	22.3
Apartment or residence	51	72,720	1,425	362,065	70,024	.962	21.8
Theatre	22	27,303	1,240	74,098	13,150	.482	12.9
Garage	13	20,001	1,540	23,670	4,049	.202	21.4
Manufacturing	19	25,601	1,350	101,831	20,695	.808	9.5
Church	9	5,904	656	17,265	3,138	.532	7.9
Hospital	4	13,226	3,306	74,046	15,773	1.194	22.0
School	8	8,917	1,115	23,250	5,273	.592	11.5
Municipal or federal	15	48,244	3,215	143,022	28,324	.587	15.6
Lodge, gym, hall or audit	12	10,583	880	21,786	4,135	.390	12.4
Miscellaneous	7	9,709	1,387	25,640	4,656	.479	21.4
Total or Average	896	1,691,513	1,890	5,743,930	1,100,691	.651	13.4

TABLE II—STEAM GENERATED

Type of building	Fuel	No. bldgs.	Volume 1000 cu ft Total	Volume 1000 cu ft Average	Heating value of fuel Total 1,000,000 Btu	Heating value of fuel 1,000 Btu/deg-day	Btu/deg-day 1,000 cu ft
Office	Coal	34	96,842	2,850	729,950	132,295	1,367
	Oil	18	30,865	1,710	143,340	52,010	1,690
	Gas	13	28,782	2,210	84,470	47,860	1,660
	C, O, & G	2	15,643	7,822	65,700	11,425	730
Total or average		67	172,132	2,565	1,023,460	243,590	1,415
Office and bank	Coal	5	31,321	6,264	137,500	24,370	777
	Oil	2	3,133	1,566	12,850	2,704	864
	Gas	2	4,386	2,193	19,500	8,210	1,870
	C, O, & G	2	10,096	5,048	51,800	9,060	898
Total or average		11	48,936	4,450	221,650	44,344	905
Office and stores	Coal	8	14,533	1,817	93,750	16,425	1,130
	Oil	2	3,690	1,845	12,240	6,500	1,760
	Gas	1	864	864	2,650	2,040	2,360
Total or average		11	19,087	1,730	108,640	24,965	1,310
Bank	Coal	1	1,229	1,229	10,000	1,710	1,390
Loft	Coal	4	34,025	8,506	114,400	19,990	588
	Oil	1	2,085	2,085	10,000	1,910	918
	Gas	1	7,873	7,873	6,454	2,340	297
Total or average		6	43,983	7,330	130,854	24,240	552
Hotel or club	Coal	1	4,677	4,677	69,000	14,800	3,160
Grand total or average		97	290,044	2,995	1,563,604	353,649	1,220

TABLE III—INFLUENCE OF TYPE OF HEATING SYSTEM ON STEAM CONSUMPTION, OFFICE BUILDINGS PURCHASING STEAM

Type of heating system	No. bldgs	Lb steam per deg-day: Actual	Lb steam per deg-day: Calculated	Diversity: Lb steam	Diversity: Factor	Average volume 1000 cu ft	Lb steam/deg-day/1000 cu ft
1-pipe-gravity	73	52,602	43,704	8,898	1.20	945	.838
Paul system	12	27,497	23,420	4,077	1.13	2,875	.797
1-pipe-vacuum	3	2,467	2,255	212	1.09	1,125	.732
2-pipe-gravity	41	30,528	28,202	2,326	1.08	928	.839
Vapor system	7	5,239	5,040	199	1.04	1,140	.656
2-pipe-vacuum	108	198,103	202,097	− 3,994	.98	2,720	.675
Orifice-gravity	24	39,353	40,575	− 1,222	.97	2,470	.663
Orifice-vacuum	65	138,183	148,781	−10,598	.93	3,410	.623
Indirect	1	820	1,420	− 600	.58	2,100	.391
Total	334	494,792	495,494	− 702		2,220	.685

TABLE IV—INFLUENCE OF KIND OF CONTROL APPARATUS ON STEAM CONSUMPTION, OFFICE BUILDINGS PURCHASING STEAM

Kind of control apparatus	No. bldgs	Lb steam per deg-day: Actual	Lb steam per deg-day: Calculated	Diversity: Lb steam	Diversity: Factor	Average volume 1000 cu ft	Lb steam/deg-day/1000 cu ft
Inside key thermostat	45	39,987	35,411	4,576	1.13	1,265	.810
Hand control	98	128,466	115,768	12,698	1.11	1,755	.771
Individual radiator thermostat	10	39,970	36,550	3,420	1.10	5,551	.719
Manual cycle	20	36,061	34,294	1,767	1.05	2,639	.682
Automatic cycle	22	32,390	32,915	− 525	.98	2,145	.685
Variable cycle	71	96,256	99,435	− 3,179	.97	1,975	.686
Pressure differential	47	79,439	85,745	− 6,306	.93	2,710	.624
High vacuum	21	42,223	55,376	−13,153	.76	3,930	.510
Total	334	494,792	495,494	− 702		2,220	.685

TABLE V—FORMULAS FOR CALCULATING STEAM USE

For Buildings Purchasing Steam			
Office buildings	$S =$ −390	$+ .65 V$	$+ 37.9 H$
Office buildings	$\text{Log } S =$ − 0.451	$+ .93 \text{ Log } V$	$+ .49 \text{ Log } H$
Office and bank	$S =$ −477	$+ .44 V$	$+ 69.2 H$
Office and printing	$S =$ −947	$+1.51 V$	$+ 23.3 H$
Office and theatre	$S =$ 1285	$+ .20 V$	$- 31.0 H$
Office and stores or shops	$S =$ 27	$+ .47 V$	$+ 16.5 H$
Banks	$S =$ −102	$+ .58 V$	$+ 23.1 H$
Department stores	$S =$ 687	$+ .39 V$	$- 60.6 H$
Stores — small	$S =$ − 8	$+ .61 V$	$+ 0.56 H$
Lofts	$S =$ −526	$+ .57 V$	$+ 54.5 H$
Warehouses	$S =$ −2229	$+ .40 V$	$+250.9 H$
Hotels and clubs	$S =$ − 4	$+ .99 V$	$+ .38 H$
Apartments or residences	$S =$ 639	$+1.10 V$	$- 38.2 H$
Theatres	$S =$ 726	$+ .36 V$	$- 45.1 H$
Garages	$S =$ 492	$+ .13 V$	$- 17.9 H$
Manufacturing	$S =$ 1022	$+ .59 V$	$-104.4 H$
Churches	$S =$ 39	$+ .28 V$	$+ 16.0 H$
Hospitals	$S =$ 924	$+1.66 V$	$-112.3 H$
Schools	$S =$ 1671	$+ .18 V$	$-105.3 H$
Government buildings	$S =$ 446	$+ .41 V$	$+ 8.0 H$
Lodges, gyms and halls	$S =$ −560	$+ .27 V$	$+ 53.4 H$
For Buildings Generating Steam with Coal			
Office buildings	$Btu =$ −1506	$+1.83 V$	$+ 12.6 H$
Office and bank	$Btu =$ 1641	$+ .67 V$	$- 61.3 H$
Office and stores	$Btu =$ 487	$+1.23 V$	$- 48.8 H$
Lofts	$Btu =$ 2268	$+ .44 V$	$- 92.1 H$
For Buildings Generating Steam with Oil			
Office buildings	$Btu =$ 1099	$+1.80 V$	$-115.2 H$
For Buildings Generating Steam with Gas			
Office buildings	$Btu =$ 1733	$+1.30 V$	$- 85.5 H$

S = Steam per degree-day, lb
H = Hours of occupancy
V = Volume in 1000 cu ft
Btu = 1000 Btu per degree-day

average. Figures for small numbers of buildings are, of couse, not as reliable as those for larger numbers. Perhaps ten buildings should be considered a minimum for reliability.

The effect of an efficient control device is greatest on an efficient heating system. For instance, hand control on a one-pipe gravity system has a diversity factor of 1.29, whereas on an orifice-vacuum system, it has 1.12, a 17-point improvement.

A combined study for all occupancy groups other than office buildings shows that inside key thermostats, hand controls, individual radiator thermostats and variable controls are relatively more efficient for this group than for office buildings. For automatic-cycle pressure-differential and high-vacuum controls the contrary seems to be true. It is probable that the latter types of heating systems and the more complicated control devices function better in office buildings where they are adequately maintained by efficient organizations.

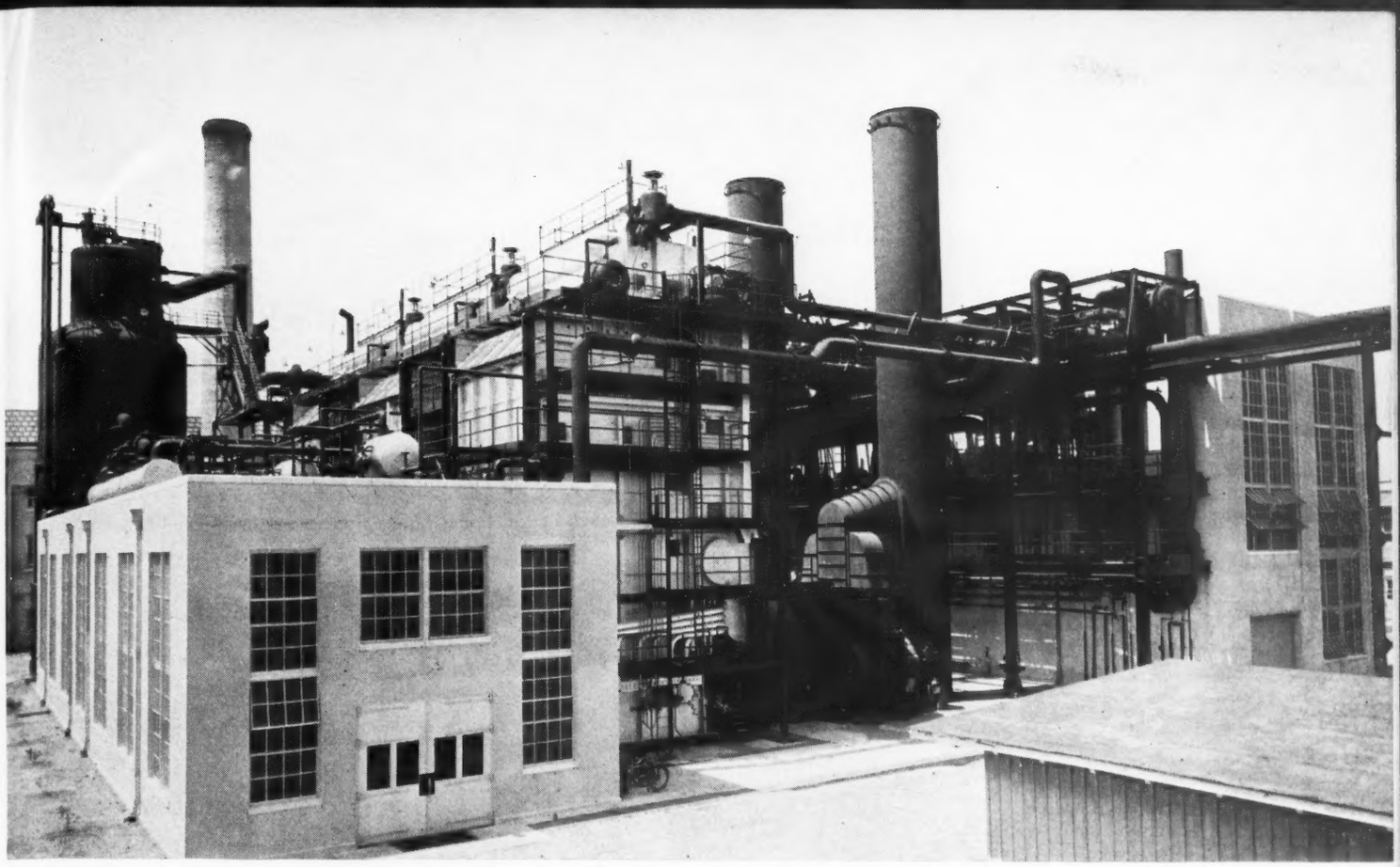
Generate Own Steam

Buildings that generate their own steam present an additional problem in the analysis and comparison of their data. Heating records are kept in terms of coal, oil, or gas supplied to the boilers and from these fuel figures must be deducted plant losses. Then the net heat can be translated into steam. In this study, all fuel figures were converted to Btu and curves drawn in terms of Btu.

Next, the amount of steam each of these buildings would have used had they purchased steam (and used it with the efficiency of the average of similar buildings that did purchase steam) was calculated. Then, approximating a lb of steam as 1000 Btu, a *fuel-conversion ratio* was determined by dividing lb of steam by the thousands of Btu. This operation gave a conversion ratio of 52% for office buildings generating their own steam with coal.

If the building operating its own plant put the same quantity of steam into its heating system as the building buying steam, then this conversion ratio would be the equivalent of boiler-plant efficiency. However, it has been found that buildings operating their own plants do not generally exercise as close control over supply to heating systems as do those purchasing steam.

Surprisingly enough, the fuel-conversion ratio for oil- and gas-fired installations was found even lower than for coal, being approximately 40% for each. Some explanation of this is found in the fact that buildings burn the latter fuels only in localities where they are relatively cheap, with the majority of them being in southern states where the heating season is both mild and short.

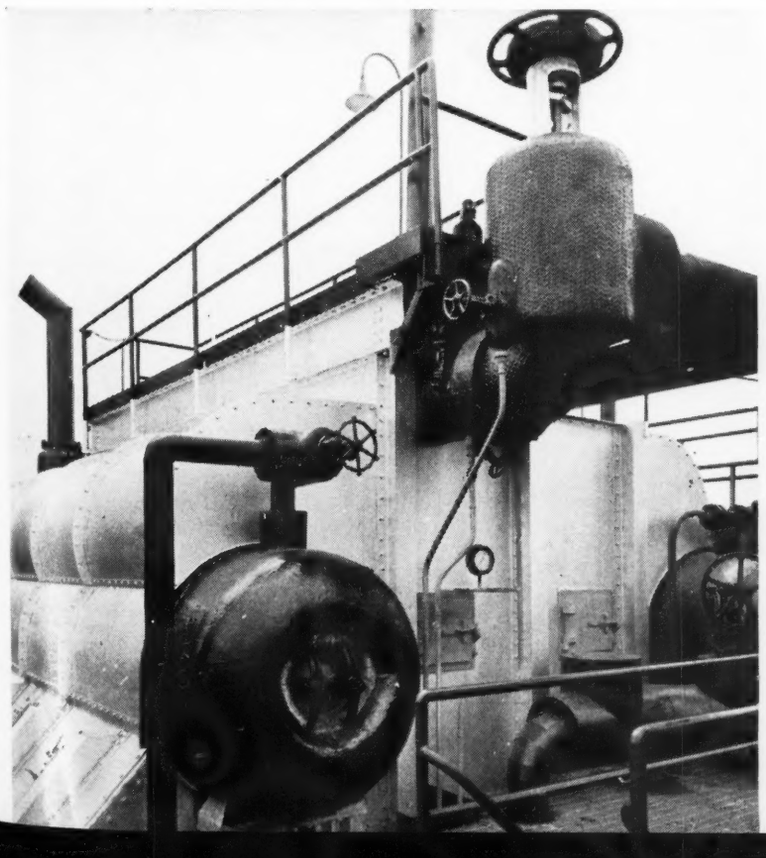


One-story building houses firing aisle and boiler-feed and fuel-oil pumps; steel-cased boilers and auxiliaries supply turbines in structure at right

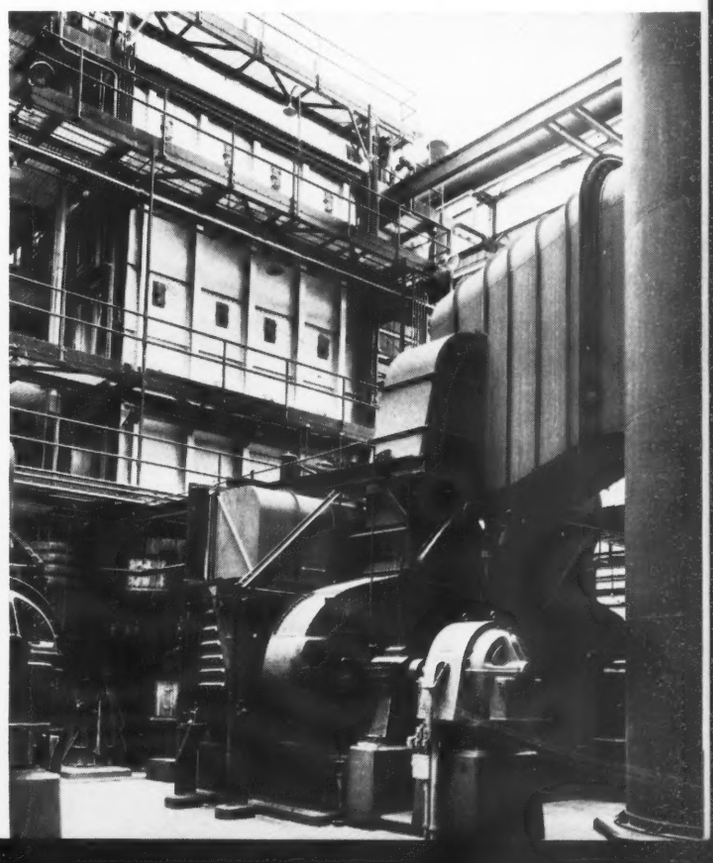
Port Arthur Steps Out

Additional photos of modernized Texas Co refinery, described on pages 59-61, show cost-saving outdoor construction

Steel casing, heavy insulation and lagging protect boiler drums, valves and piping



Induced- and forced-draft fan sets stand behind boilers with stack at extreme right. Note inclosed motors



In the News of the Day

Dow Chemical Plans Plant on Gulf Coast Site

MIDLAND, Mich., March 18.—Willard H. Dow, president and general manager, the Dow Chemical Co has announced purchase of 800 acres of land with about three miles harbor frontage on the Gulf Coast Freeport, Tex. The company plans large industrial development on site devoted principally to the utilization of sea water as a raw source magnesium. Many contracts have been let for necessary equipment plant buildings, laboratories executive offices, which when completed will involve an expenditure approximately $5,000,000

Kennecott Reports Sharp Gain in Earnings

Company Earned $3.14 Per Share Last Year, Against $2.10 During 1938

NEW YORK, Copper Corp.'s a year 1939 release couraging gain in past

U. S. Steel Common Dividend Seen as Sign of Confidence

NEW YORK, March 27 (U.P.) United States Steel Corp.'s "off da declaration of $1 a share dividend stock was regarded in ... that

Wheeling Steel Corp.'s Ne... Profit During the Past Y... Is Best Recorded Since

Company Heads Give Views

Shell and American Water Works Officials Tell of Progress.

The following heads of various corporations these views in statements to stockhold

...tion, R. G. ... American Water W... Inc., H.

Sharp Gain!

Burroughs Domestic Sales Soar 16 Per Cent

...machine sales of B... ...ing Machine Comp... ...rch quarter were ... ...ent ahead of the ... ...Standish P...

Scovill Mfg. Co.'s Earn... Record Substantial Gain

WATERBURY, Conn., March Scovill Mfg. Co. and subsidiarie... ports a 1939 net profit of $1,7... After deducting $137,957 trans... to inventory reserves there w... balance of $1,630,851 added to plus.

In 1938 net loss was $31,920 an... cluding $170,091 reductio... tory reserves ... these ...

Booming Arsenal Turns Out Super Shell at Frankford

Anti-Aircraft Missiles, Only Ones of Kind In World, Are Like Jewels of Death: 3,800 Workers

Westinghouse Orders Up Shar...

Show 37½% Gain Over 1939—Backlog Of U... Now Over $80,000,000

Buzzard Point Extension

Construction of the 50,000-kw exten... to the Buzzard Point of the Potomac E... tric Power Co. in Washington, has ... Stone & Webster E... been ... Corp... and subsidiaries in the 12 mo... orig... ended Feb. 28 had net income $... wou... 658,605, equal after dividend ... pre... quirements on the $6 preferred ... the... which there is an accumulation ... au... unpaid dividends, to 14 cents ... fa... 33,673,327 common shares, agai... revised net income $11,119,647, o... cents a common share in the ... months ended Feb. 28, 1938. For ... the first two months of this year ... net income was $3,123,092, or 5 ... cents a common share ...

Celanese Enjoying Good Quarter...

Expected To Show About $1.50 A Share ... Months

New York—As a result of continued stron... acetate rayon this year, earnings of Celanese Corp... rent quarter are expected to be in the neighborho... share. This would compare with about $1.20 ea... final quarter of last ... cents a share in ...

Flintkote 12-Week Net Advances to $114,318

Flintkote Co. and its subsidiaries ... report for three four-week periods ... ended March 23, 1940, net income of ... $114,318 after Federal, state and for... eign taxes, equivalent to 17 cents a ... This compares with net in... cents a share,

Curtiss-Wright Corp. Earns 37c Per Share

NEW YORK, March 29—(A. P.) —Curtiss-Wright Corp., today re... ported 1939 consolidated net profit ... of $5,218,259 after charges, equal ... after class A stock dividend re... quirements to 37 cents a com... mon share.

This compared with $3,598,739 or ... cents a common share in 1938. ... W. Vaughan, president, announced b... ...ed orders March 8 of this ... $144,930,904, com... ...546,521 a year ...

...ne special not... provides direction... for absolutely ... The jacket is m...

Godchaux Sugars, Inc.—For fiscal year ended Jan. 31, 1940, net income $558,544, or 37 cents a Class B share; for previous year, net income $492,265, or $3.58 a Class A share.

Remington A... Develops I... Soft Po...

Continent... Improved ...

NEW YO... ...nths en...

Motor ... $420,40...

DETRO... Corp. rep...

Koppers Co... Period Net ...

PITTSBURG... Co. reports ... of $2,239,001, ... on 6 per cent ... for 12 mon... against $1,07...

Timken Ro... Earns $1.2...

CANTON, ... Roller Bearin... profit of $2,8... ended March ... share, against ... a share in Ma...

Internatio... Machines'

NEW YOR... tional Busine... first quarter ... after deducti... eign net pr... a shar...

Republic Steel Corporation Urges Prosperous Profits

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Tacoma Baltimore Milwaukee Denver St. Louis Cincinnati Houston Chicago St. Paul Kansas City Los Angeles Atlanta Memphis New Orleans

It will pay you to visit modern Riley Installations

United Illuminating Co. to Spend $5,500,000

UNITED Illuminating Co. plans to spend $5-500,000 during the current year and 1941 for improvements and additions, according to James W. Hook, president.

Among the improvements planned are a 25,000-kw. generator for the Steel Point plant at Bridgeport, Conn., and a new 13.8-kv. bus for the station. There is also to be a 66-kv two-circuit tie between the Bridgeport an-

Allis-Chalmers Reports Improved Earnings

MILWAUKEE, May 3.—Allis-Chalmers Mfg. Co. reports net profit of $969,869 for the quarter ended March 31, equal to 54 cents a share on 1,776,092 shares of common stock, against $710 a share for quarter

Union Electric Company to Expend $20,000,000 For Expansion

UNION ELECTRIC Co. of Missouri, Inc., Twelfth and Locust Streets, St. Mo., is arranging an appropria- for expansion

National Lead's Sales And Net Larger

Modest Gains Scored In First Quarter Despite Unfavorable Weather Conditions—Prospects Favorable

Operations of National Lead Co. in the first ...arstood to have made a satisfactory ...and earnings for

Union Carbide Net Gain Maintained

Over $1 A Share Earned For Quarter, Against 76 Cents A Year Before

New York—Earnings of Union Carbide & Carbon Corp. th... arch quarter will probably run somewhat over $1 a share ...ainst 58 cents a share ... cember quarter, which ...

Oklahoma Gas 12-Month Net At $2,820,507

...arter Rises From $... in Period End... 1939; Gross Sl...

Net income of Oklah... Electric Co. for twelve mo... Jan. 31 amounted to $2,8... all deductions. J. F. Ow...

NORTON COMPANY ADDING TO POWER PLANT

Norton Company of Worcester has started to install ...erating equipment in its power plant which will incr... capacity from 500 kw ... kw. The company's pr... sumption totals ab...t ...being purch...

Libbey - Owens Quarter Net Up To $2,897,952

Equal to $4.16 on Common, as Against $1,195,025, or $1.71, Previous Per...

...ated net income o... man Corp. and subs... y-three-week period ... amounted to $2,5... preferred dividend... mon share. This c... a net income of $1,... a common share, in... nded Feb. 25 1939...

Masonite Corporation, twel... ended March 16, net profit ... equal to 43 cents a share on ... mon stock, against $223,411 ... cents a common share for the twelve ... weeks ended March 11, 1939. For the ...

Collins, Aikman Net in Year Up To $2,556,895

Henry Disston & Sons Celebrating 100th Anniversary

Hold Week's Celebration in Honor of Founding of Company Century Ago

PHILADELPHIA, May 27.—Henry Disston & Sons, Inc., Tacony, Philadelphia, last Friday began a week's celebration of the one-hundredth anniversary of t... ...ablishment of this ... ...any is ...re of ...bout The ...ked ...cial ...ton ...one ...ver-

...Horace Disston es... ...the founder and now ...ed of the company placed rec... ...mentoes under...

Owens-Illinois Glass Earned $3.34 On Common In 12 Months

Toledo—For 12 months ended March 31, 1940, net profit ... was $8,884,066, equal to $3.34 a share on 2,661,204 shares of ...T $12.50 par common, against $5,948,561, or $2.24 a share for ... 12 months ended March 31, 1939.

JOHNS-MANVILLE SALES ABOVE 1939

First-Quarter Net Will Probably Exceed The $125,118 Shown A Year Ago

New York—That earnings of Johns-Manville Corp ...quarter should show a gain over the $125,118 net a year ... the annual meeting in say... ...while under ... income $...

General Electric Co. Earns $1.43 a Common Share

SCHENECTADY, N. Y., March 20.—General Electric Co.'s pamphlet report for the year ended Dec. 31, 1939 shows a net profit of $41,235,644, equal to $1.43 a common share, against $27,729,329 or 96 cents a common share in 1938.

Florence Stove Co.'s Net Earnings Improve

BOSTON, April 17. — ...was Stove Co. for the quarter ... ...after ...

Florida Power & Light Plans $3,000,000 Unit

FLORIDA Power & Light Co. will unde... a $3,000,000 expansion program at... Dania plant, according to Bryan C. Hi... president. The capacity of the plant w... increased 50 per cent by the installation of a 25,000-kw. steam turbo-generator and auxiliary equipment. The transmission and distribution system will also be enlarged and revamped to handle the growth in load.

National Cash Register Co. Earns $1,805,086 in 1939

BALTIMORE, March 19.—National ... h., cc... Cash Register Co. and ... for the ye... port ...

Norwich Orders New Generating Equipment

Orders have just been pl... Norwich, Conn., municipal ... partment with Riley Stoker Corp. for a complete boiler unit with a capacity of

COMMONWEALTH & SOUTHERN OUTPUT UP 21%

New York—Electric output of Commonwealth & Southern Corp. System for February was 693,390,801 kwh., against 572,849,679 kwh. for February, 1939, an increase of 21%.

...onths ended Feb. 29, 1940, output ... 173,265 ...nst 1,204,376,473 kwh. for ... period, an 20.4%.

...output for the ... Feb. 29, 1940, was 8,090,... ... kwh. for year ended ...

Crown Cork Aided By Seamless Cans

...pull buying of the shares on the belief that the company's seamless ...can sales will begin to produce satisfactory profits ...

Bayou—Humble Oil & Refining Co. ... Tex... ...plans expansion program for refinery plants ... About $2,500,000. ... steel ta...

CONTAINER OF AMER...—March ... quarter net profit $509,714, or 65 ...e o'cents a share ... ...

Crown Cork & Seal is one of the strongest stocks, being active and selling into new high ground for the year. There is lon... ...

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

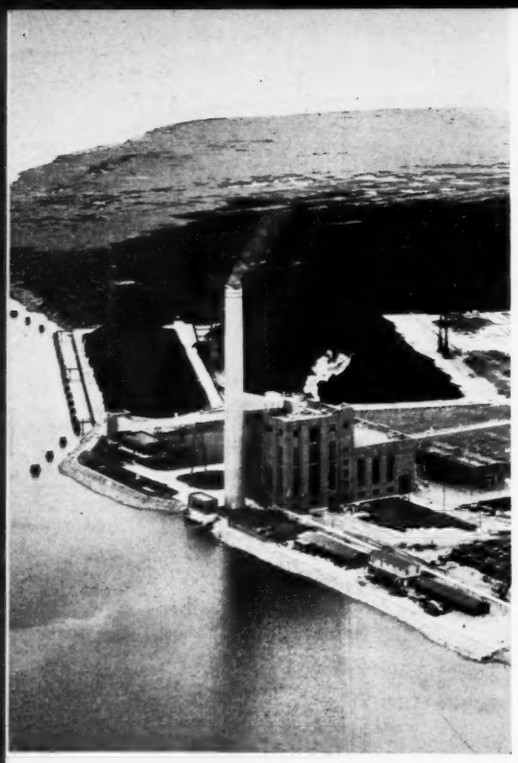
COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

...ions before purchasing Boiler or Fuel Burning Equipment

...hundreds ...Combustion Engineering



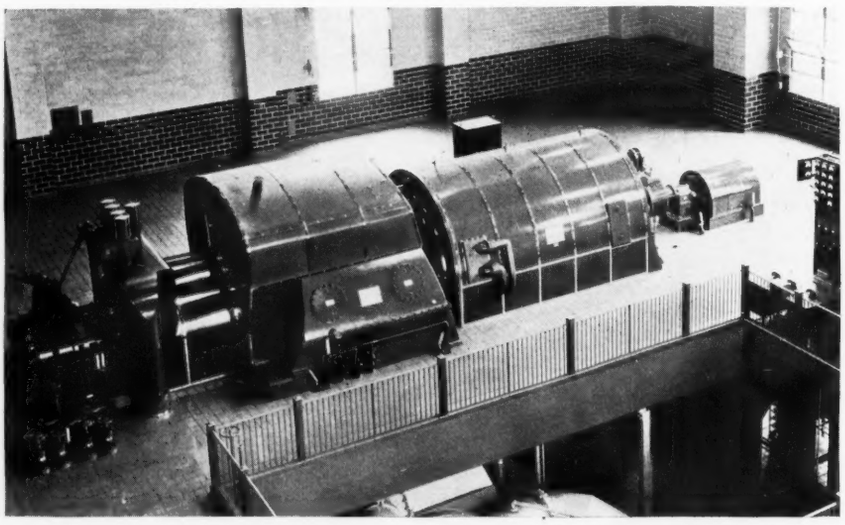
DEDICATED to PRODUCTION

▶ The important industrial area of Bay City, Flint and Saginaw, Michigan, where increased activity is expected as a result of defense orders, got a sturdy power guarantee when the new John C Weadock Station of Consumers Power Co was dedicated June 20.

The plant contains at present one 35,000-kw, 21-stage, 3600-rpm, hydrogen-cooled, General Electric turbine-generator, and two 400,000-lb-per-hr Foster Wheeler boilers. Another 35,000-kw unit is on order to go into service June 1941. Consumers Power now has 508,715 kw of capacity, including the 35,000 at Weadock; by the end of next year this figure will rise to approximately 600,000 kw when the new Kalamazoo plant is finished. Lower photo shows the turbine room of E I du Pont Co's new Nylon plant at Seaford, Delaware, with two Westinghouse 7500-kw units.

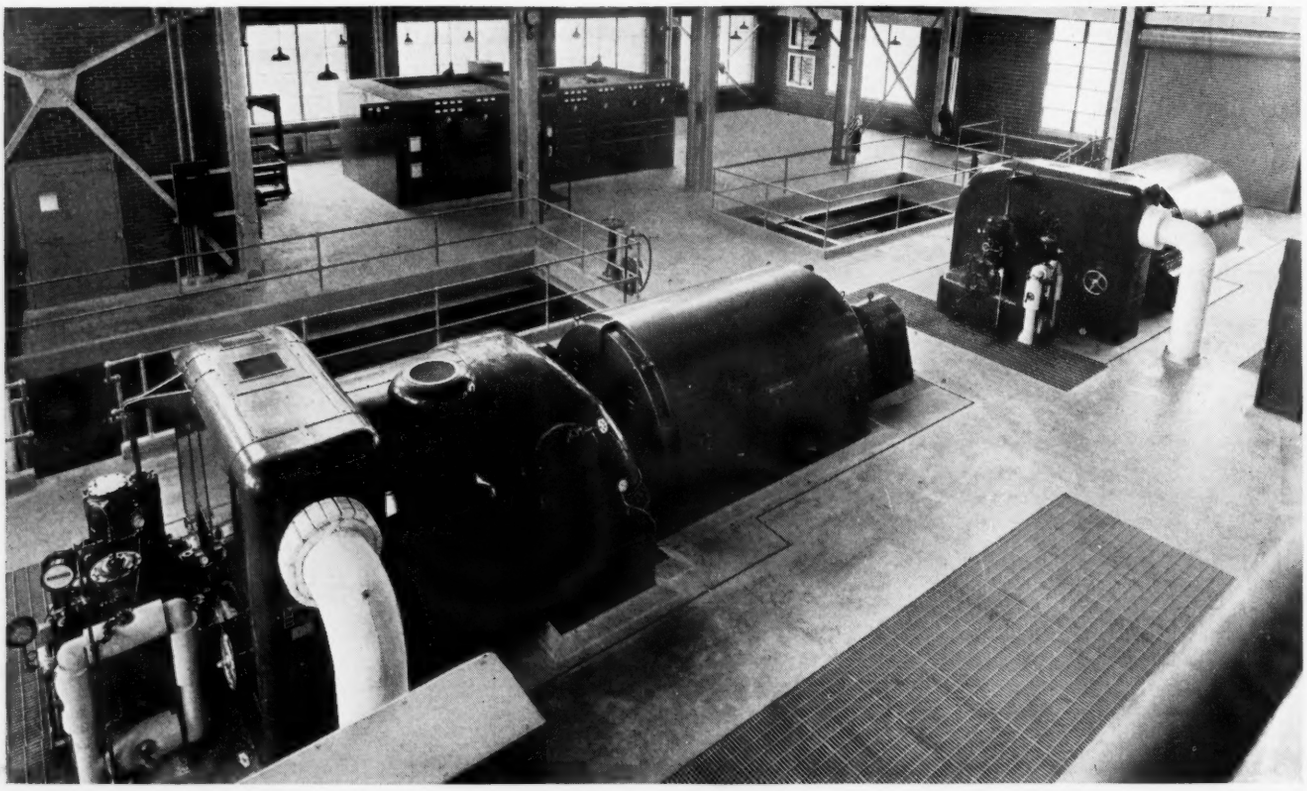
These new plants are only two of the many installed or placed on order in the past 12 months—power engineers, both industrial and utility, are moving wheels to the end that there will be no power shortage this year, the next, or even 1942.

John C Weadock Station of Consumers Power Co is situated on the land tip where Lake Huron and the Saginaw River join. Because the river is frozen from November until April, sufficient coal for this period must be stored at the plant



35,000-kw General Electric turbine for John C Weadock Station takes steam at 800 lb, 850 F. Installation of a sister unit is to begin within a few months

Sheer power for Nylon is turned out by these two 7500-kw, 3600-rpm, Westinghouse turbine-generators for E I du Pont Co's new plant at Seaford, Delaware. Steam conditions are 525 lb, 700 F, with extraction at 20 lb g for process



II—KANNAPOLIS • CHARLOTTE • GREENVILLE • ASHEVILLE • CANTON • ELIZABETHTON

CAROLINA CIRCUIT

Concluding installment of Editor Phil Swain's engineering rambles through North Carolina

► BEFORE I LEFT BUCK STATION of Duke Power Co, plant superintendent W E MacDowell put in a long-distance call to Kannapolis and wheedled E M Ketchie, chief steam engineer of Cannon Mills Co, into coming back to his plant of a Saturday afternoon to show the editor and wife around the works. Since a lady was involved, Mr Ketchie, as a chivalrous Southerner, could not refuse. I had such circumstances in mind when I took Mrs Swain with me on this trip.

We had a fine trip through the big Cannon mills. Employees number 15,000, and the company YMCA has 12,000 members (which number includes women, strangely enough). The neat boiler room generates steam for process only. All power is purchased from Duke at a very reasonable rate. Cannon Mills Co is the largest manufacturer of towels in the world, and the only industry in Kannapolis, largest unincorporated city in the United States.

Charlotte and Duke Power

Sunday morning in Charlotte we followed the local style and went to church. This city, like Raleigh, is full of churches. Charlotte is a very beautiful city and the largest in North Carolina. Business center is ship-shape, up and coming. Outskirts are full of green trees and fine homes. They say the Mecklenburg Declaration of Independence was indited here just one year before the official Philadelphia document, May 20, 1775.

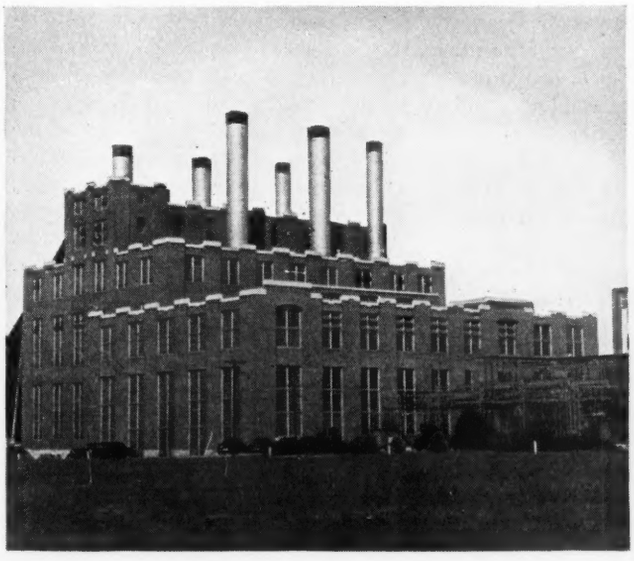
Throughout our stay in Charlotte, Mrs Swain and I were well taken care of by Mr and Mrs E E Williams. Mr Williams, a Georgia Tech graduate, is general superintendent of steam plants for Duke Power. Sunday afternoon he drove us out to Duke's River Bend plant, beautifully located in open country, spotlessly clean, well lighted. Nearby was a pleasantly situated village for the plant personnel. At the plant we met J H Sadler (superintendent), J M Craig (assistant superintendent), George Craig (chief operator), and Donald Knight (test engineer), all of whom seemed to enjoy living and working in this clean-country environment.

The older section of River Bend has been running about ten years, has two 55,000-kw turbines operating at 425 lb and 750 F. A third 55,000-kw unit (650 lb and 825 F) was started in 1938. Mr Williams told me that this unit has an availability record of practically 100%. The entire plant operates on pulverized coal. River Bend has no automatic combustion control. Mr Williams feels that he can get practically the same results with hand control on base-load operation.

On the way back to Charlotte, we took a look at the Mount Island 60,000-kw hydro plant (about 2 miles from River Bend) and the Mount Holly 32,000-kw standby steam plant. Until last year Mount Holly stood idle for about ten years, and was then started up in a couple of days to run for months. It may be another ten years before it has to run again. For dead standby this plant was in a phenomenal condition of upkeep—brightly painted, spotless turbine room, drying lamps kept burning in key motors, etc.

On Monday (May 13) I visited the main offices of Duke Power, where Mr Williams introduced me to Roy Palmer, president of Charlotte Engineers Club, George E Wilkinson, chairman of the program committee, fine fellows and very cordial.

A very pleasant memory of this visit to Duke headquarters was a half hour spent with C I Burkholder, vice-president and chief engineer. Mr Burk-



River Bend Station of Duke Power Company stands in open country, as do the Buck and Cliffside plants

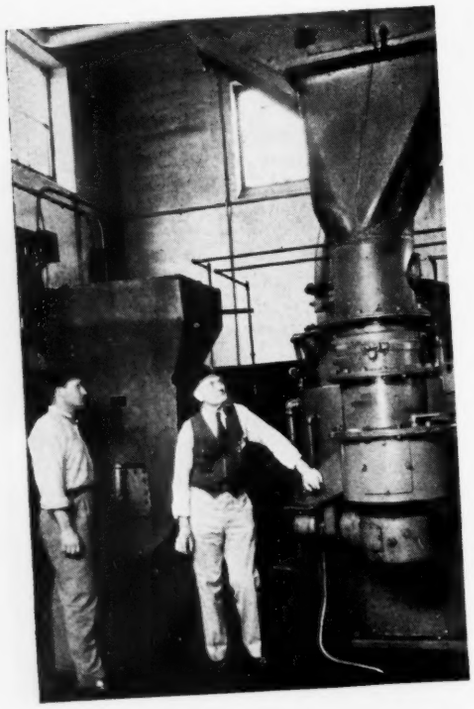
These men run River Bend. Left to right: J H Sadler, J M Craig, George Craig, Donald Knight

holder is one of those men who has risen to an executive position from first hand contact with practical everyday affairs. His mechanical background includes early work with General Electric and shinnying a lot of transmission towers. Mr Burkholder fully agreed with my often-expressed opinion that every college man should get early mechanical experience.

Had another interesting session with D Nabow, design engineer for Duke Power. It is always a pleasure to talk with Mr Nabow, whose interests and thinking extend far beyond the immediate aspects of his technical power job.

After presenting a travelog (something like the one I gave in Raleigh) before about 70 members of the Charlotte Engineers Club at luncheon, I called on a number of manufacturers' representatives in town. Among these was my now good friend, Theodore Heyward, who heads the regional offices of Combustion, Carrier, and Wheeler. There also I met Carl Weston, a salesman who gave me many helpful suggestions for my southern trip of 1935.

After a brief stop at the Ruby Co Cotton Mills in Gastonia, I drove to Cliffside to inspect the Cliffside plant of Duke Power Co, now nearing completion. This is a fine plant, but I am not at liberty to give technical details. At the plant I talked with J H Erskine, who will operate it when completed, also again met Mr Burkholder on a round of inspection.



Father and son run engineering at Southern Bleacheries & Print Works, Greenville, S. C. The father, L W Meisenheimer, master mechanic, has his hand on new coal-pulverizing ball mill. At left is his son, L S Meisenheimer, in charge of the steam plant

Greenville

Spent the night at the lovely Poinsett Hotel in Greenville, South Carolina, and Wednesday morning with George R Morgan of J E Sirrine & Co, consulting engineers. Sirrine & Co has been prominent in the industrial life of this region for forty years. They do no construction, consulting only. Total payroll is around 75, including several resident engineers out on the job and about 40 men in the drafting room. J E Sirrine is president. Mr Morgan heads the steam department, George Wrigley the electrical department. Other departments are civil, textile machinery, architectural, buildings and plans, chemical engineering.

H H Iler, plant engineer, Union Bleacheries, Greenville, S. C.

While in Greenville I seized the opportunity to inspect the job of modernization done by Sirrine in the plant of the Southern Bleachery & Print Works. L W Meisenheimer is master mechanic. His son, L S, is in charge of the steam plant. To replace an old group of hrt units, a 68,000-lb-per-hr B & W Integral-Furnace boiler was installed in 1937. This generates steam at 215 lb (design pressure) and 540 F. Other new equipment includes a pulverizer, Richardson automatic coal scales, Sturtevant draft fans, Elliott centrifugal feed pumps, a 120-ton coal silo mounted on a concrete slab supported on the roof steel work, Jeffrey coal-handling (track hopper, horizontal belt conveyor and elevator), Diamond soot blowers, Bailey control and feedwater regulator. Reliance inclined water gage, Yarway blowdown valve, Cochrane deaerating heater, Roberts zeolite softener, etc. The steam goes to an existing condensing turbine and is extracted at 40 lb for bleachery process. Additional power is bought from the Duke Power Co. Very little steam goes to condenser.

On the way out of town, headed for Asheville, I stopped at Union Bleacheries to renew my acquaintance with H H Iler, plant engineer and chairman of the program committee of the Greenville section of the ASME. Mr Iler showed me over this plant and introduced me to C A Spencer, power engineer.

Asheville, Canton

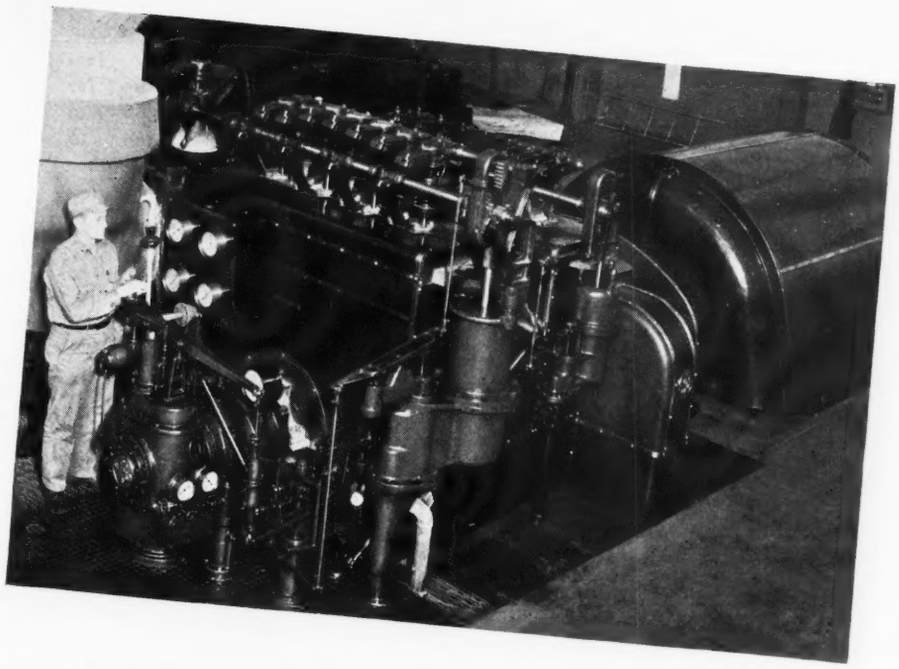
Then on up across the Blue Ridge Mountains to Asheville. This beautiful city of 50,000 inhabitants, at 2500 ft elevation, is a famous health resort. Asheville is notable for its fine stores and homes and for the great estates in the surrounding hills.

Thursday morning (May 16) I drove south about 10 miles to Canton to pay another visit to the big plant of the Canton division of Champion Paper & Fibre Co. Canton (population about 5000) has about the same elevation as Asheville, and a correspondingly wonderful climate. Here it is possible for a mill worker to have a little home up in the high hills, yet just a few minutes' run by automobile from his job. For bigger mountains, he has to go only a few miles to the "Old Smokies."

Men met at this big plant included H A Helder, the energetic plant manager, W W Mitchell, superintendent of power, and Harold Hansen, general foreman in charge of power. Champion's Canton plant nicely illustrates the importance of the steam end in a big process plant. The budget of the power department runs around $20,000 a week, or about $1,000,000 per year. The installed generating capacity is 22,500 kw, but since most of the processes are operated by bled or back-pressure steam, this kilowatt capacity represents a far larger steaming capacity than would be the case in a central station.

Thus Champion has a total steam generating capacity of around 850,000 lb per hour. Maximum actual steam load is about 650,000 lb per hour. Most of this steam is generated at 400 lb and 700 F by pulverized coal.

I was told that steam-generating efficiency of the pulverized-coal-fired



New 7500-kw backpressure extraction turbine brings generating capacity of Champion Paper & Fibre Co at Canton, N.C., to 22,500 kw

plant averages about 88%. They keep elaborate records and run a continuous test. The remaining steam is produced by waste fuel in five Murray-Waern units, in some home-assembled bark-burning boilers and in a new Combustion Engineering spray-type unit for black-liquor recovery. The latter generates 50,000 lb per hr at 400 lb and 700 F.

Prime movers include a twin Corliss engine (1150 kw), two Allis-Chalmers turbines (1250 and 750 kw), Westinghouse mixed-pressure condensing turbine (3000 kw), two Westinghouse extraction backpressure turbines (4000 kw each), and a new GE extraction backpressure turbine (7500 kw). These three largest units take steam at 400 lb and 700 F. The Westinghouse extraction backpressure turbines extract at 125 lb and exhaust at 30.

The latest GE unit, installed in 1937 to give needed new capacity, extracts at 125 lb, exhausts at 30 lb, and runs 3600 rpm. About 2000 kw of the generating capacity is direct current for the electrolytic production of chlorine. The plant is synchronized with the Carolina Light & Power Co. There is some power exchange, but always a net input.

The process steam at 30 lb is used for most processes, but 125 lb is required for the digesters.

Steam is metered separately to each department. A central board carries 35 indicating, recording and integrating flowmeters, in addition to some meters near the application points. Consumption records are turned in to the accounting department and billed each month to the using departments. Plant manager H A Helder is a great believer in metering. He told me he would also meter water to each department, except that the lines were not originally laid out so as to make this practicable.

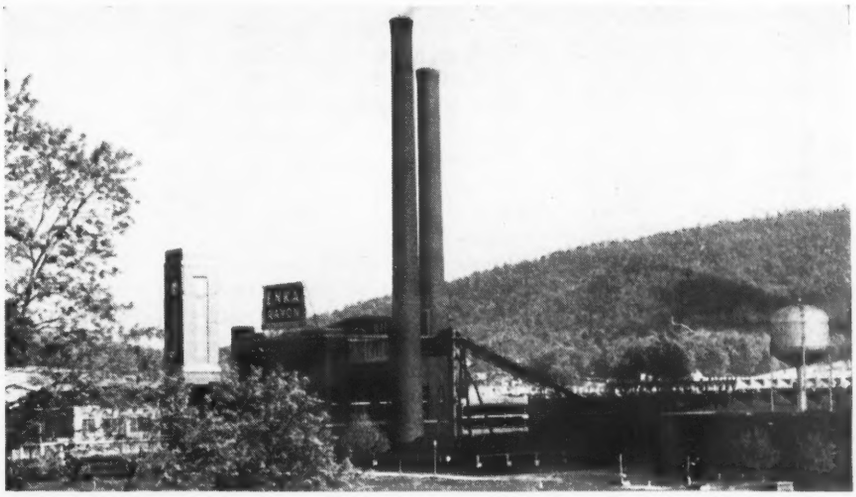
This Champion plant produces about 450 tons of pulp per day, also a lot of finished paper. The accounting system is based on 13 four-week periods.

Elizabethton, Kingsport

I had planned to remain several days in Asheville, but Elmer Torok (power engineer for North American Rayon Corp and American Bemberg Corp, Elizabethton, Tenn.) had signed me up at the last minute for an ASME program in Kingsport, Tenn., on May 17. This forced me to drive over the mountains between Elizabethton and Asheville three times. The effort was well repaid in scenery, hospitality and engineering education. At points this road north of Asheville reaches an elevation of 4000 ft, winding like a snake through some of the most beautiful mountain country in eastern America.

Arriving about noon on Friday (May 17) at Mr Torok's fine home in Elizabethton, we were greeted by Mrs Torok who drove us to Kingsport, Tenn. Mr Torok was busy at the plant, so came over later in the afternoon. The Knoxville section of the ASME was having its annual meeting in Kingsport. I attended sessions, joined the inspection trip to the splendid plants of Kingsport Press and Tennessee Eastman Corpora-

(*Continued on page 132*)



American Enka, near Asheville, sets industrial efficiency in a bower of natural beauty

At Home—Elmer Torok, power engineer for North American Rayon Corp and American Bemberg Corp, and Mrs Torok

Speaking of Power

As I sit down to the monthly stint, I find it impossible to escape the atmosphere of war. The situation in Europe is so bad at this writing that I can see no reason to expect any good foreign news within the next few weeks, except what might be called "good" by comparison with something worse. . . . These terrible events

Can expect no good news

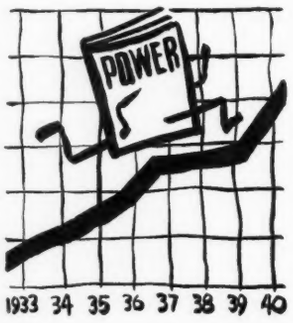
don't mix well with the "light reading" to which this page is dedicated, so let me confine myself here to the usual run of engineering and editorial gossip, and refer defense-minded readers to the editorial on page 55.

Turning your attention to the peaceful arts, for the moment, you will find, on page 91, the concluding installment of my third travelog—the story of my recent Carolina trip. . . . The first of these travelogs, published in 1936, reported a European trip of that year. The next, in the latter half of 1939, gave readers my impressions of engineers and plants up and down the West Coast. Now comes North Carolina, with bits of Virginia, South Carolina and Tennessee. . . . I was particularly impressed by the high country of western North Carolina and eastern Tennessee. Since climate is as much a matter of altitude as latitude, much of this region is cooler in summer than certain points far to the north. This is a land of great charm and natural beauty, yet one far different from the dreamy South of the story books. Here the visiting engineer can see some of America's finest industrial establishments. . . . I recall seeing at least half a dozen industrial plants whose individual steaming capacity ranged from half a million to a million pounds per hour, and whose electrical generating capacity ran from 10,000 to 25,000 kw. Not merely big, these plants were notable examples of first-class design, construction, operation and maintenance.

The industrial progress of the South is one of the notable phenomena of our age. No longer content just to raise cotton and let the North make its manufactured goods, Dixie is becoming a land of machines and engineers. It is rounding out the pattern of its economic life, and is thereby raising the living standards of all its people. . . . To me, as a northerner, it seems that this industrial blossoming of the South will be a blessing to the whole nation in the long run, in spite of the resulting temporary dislocations in certain northern communities.

Dixie gets new outfit

Note to Value-Wise Power Engineers: In checking on our editorial output for the past eight years, we have discovered an interesting fact, one that perhaps we should have bragged about before. . . . Since POWER went from a weekly to a monthly magazine in July, 1932, the number of editorial pages published each year has increased steadily. Starting with 720 editorial pages for the 12 months, July, 1932, through June, 1933, the curve sweeps steadily upwards, and has now reached 890 pages for the period July, 1939, through June, 1940. In other words, this issue has 15 more pages of editorial information than did POWER for August, 1932. . . . We feel like writing an ad, beginning with the phrase, "More for Your Money".



Editorial pages increase every year

It's axiomatic that no publication can afford to stand pat. Thus, that we may not be caught with our britches at sunset and that you, as readers and customers, may get the best possible "break", POWER constantly gives more and better information, illustrated and presented in clearer and more pleasing fashion.

At time of writing (July 10), returns are coming for the tables of new hydro and steam-plant installations, to be published in September POWER. Without much question 1939 was, and 1940 is to be, a banner year for power-equipment orders. Our list, by no means yet complete, includes 87 utility, 74 municipal, 112 hydro and a yet undetermined but large number of industrial installations. Of the 112 hydro, 72 are for the continental U. S., the rest for Canada and American possessions. . . . Many of the reports are for units to start operation this fall and winter, and regardless of the outcome of European events or election excitement, power will be available for any national defense program considered so far.

Returns coming in for new-plant tabulation

These tabulations, incidentally, involve a tremendous amount of work. First, we write to all manufacturers of boilers and turbines for their sales lists. Then, to each purchaser, we send another letter asking for complete plant information. Thus far, we have boosted Postmaster Farley's labors by about 1000 letters. Add to this the work of sorting, compiling, digging up missing data, checking and cross-checking, and the result is three hundred or so man-hours of effort. . . . An unlooked for dividend is the fact that several members of the staff are becoming experts on exotically named places through association by courier with such towns as Bean Blossom, Indiana; South Porcupine, Ontario; Beach Bottom, W. Va.; Reform, Ala., Itta Bena, La.; Sleepy Eye, Minn.—*PWS.*

THE OPERATING ENGINEER

George Edwards
Advisory Editor

Practical Aids
Maintenance Hints
Questions — Answers

Published monthly as an integral part of POWER

THIS HOSPITAL PLANT *Took the Doctor's Advice*

Forward-looking St Lukes Hospital engineers modernize the power plant. Results are good efficiency and high reliability at an annual load of 136,000,000 lb of steam and 1,455,000 kwhr

▶ A LARGE METROPOLITAN HOSPITAL requires all the services associated with other types of buildings and a lot of others peculiar to itself. St Lukes Hospital, occupying the block bounded by Amsterdam Ave, Morningside Drive, 113th and 114th Sts, New York, N. Y., is an outstanding example of such an institution. In addition to the main hospital there is a large nurses' residence across the street. All power, heat and refrigeration are supplied from a steam plant in the basement of the main building.

This hospital, like most other great institutions, has grown from a modest beginning, and has always operated its own power plant. In 1938 St Lukes had six boilers. Two oil-fired water-tube units, each with 2860 sq ft of effective water-heating surface, designed for 300-lb and operated at 100-lb g pressure, had been installed in 1923. These boilers were in good condition and could be operated at a higher pressure. Two older oil-fired water-tube boilers, each with 1940 sq ft of heating surface, designed for 200 lb, were operated at plant pressure. The other two boilers, 35-year-old coal-fired units, were about ready for the scrap heap.

The power-generating equipment consisted of a 75-kw geared-turbine generator, three old 50-kw engine-driven generators and a modern 150-kw generator connected to a high-speed uniflow engine.

This power plant had become inadequate for the load. The new nurses' residence about to be built across the street from the main building was far enough away from the power plant to make a 120- and 240-volt 3-wire power system desirable. Syska & Hennessy were employed as consulting engineers and Marc Eidlitz Co as builders to work out plans for modernizing the power-generating and distribution systems.

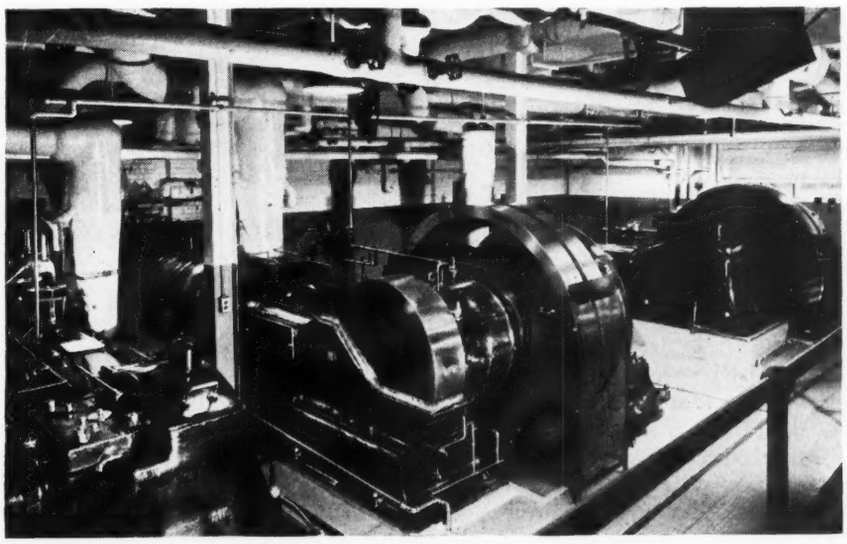


Fig. 1—St Lukes has one 200-kw and two 150-kw engine-driven generators

Steam Demand

St Lukes Hospital, in addition to requiring high-pressure steam for cooking, sterilizing and similar purposes, and low-pressure steam for building heating, etc, also needs high-pressure steam for laundry mangles and large quantities of low-pressure steam for water heating. In a hospital, the heating season is considerably longer than in other types of public buildings. All these factors combine to create a demand for low-pressure heating steam that utilizes all the exhaust from the engines for over 8 months each year. Consequently, power is generated as a byproduct from heating steam for about two-thirds of the year. Because of the

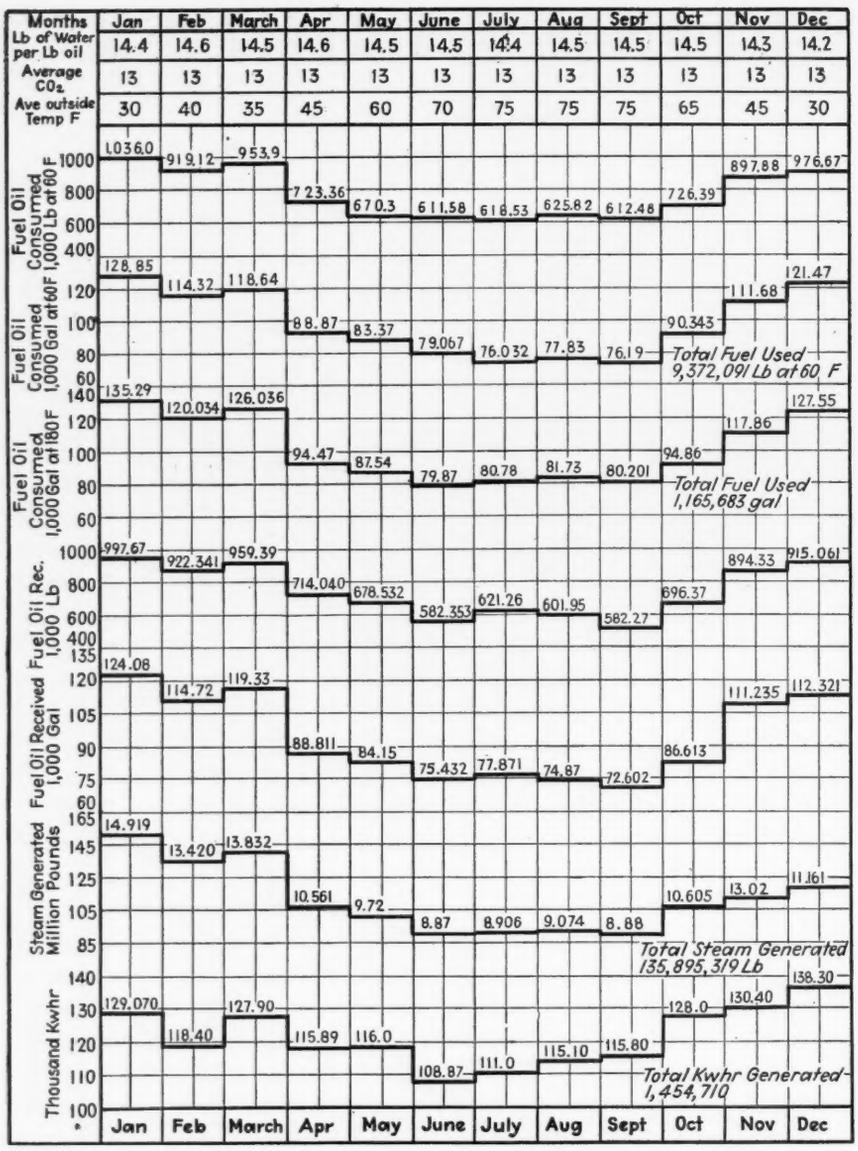


Fig. 2—Monthly and annual records of plant operation in 1939

large hot-water requirement, exhaust to atmosphere is at no time very much.

First step in the modernization program was to remove the two old coal-fired boilers and install a new cross-drum, 5000-sq-ft, water-tube boiler designed for 250-lb pressure. This unit is oil fired by three steam-atomizing burners arranged in a horizontal line across the furnace wall under the low end of the boiler. Flame travel is toward the high end of the boiler, which gives maximum flame length and best combustion efficiency for a given furnace height.

All power-generating equipment was scrapped, with the exception of the 150-kw uniflow-engine-driven generator. New capacity included 150-kw and 200-kw, 120- and 240-volt, 3-wire generators, each driven by a poppet-valve engine. The older 150-kw generator was rewound for 120- and 240-volt 3-wire operation, and a new switchboard installed for the generators and distribution system.

To reduce exhaust-steam losses during the off-heating season, steam pressure was increased to 150 lb g. The uniflow engine could operate satisfactorily at this pressure and it was only a matter of safety-valve adjustment on the older boilers to assure satisfactory 150-lb operation.

A symmetrical plant design has been obtained without any indications of a rebuilt job. There remains plenty of room around the equipment; space has also been provided for a fourth power-generating unit in the engine room when this becomes necessary. Sufficient boiler capacity is now installed to take care of a fourth engine.

All condensate from the heating system and other sources is returned to the plant and used for feedwater. Since condensed exhaust steam from the engines is used for feedwater, the problem of keeping engine cylinder oil out of the boilers is ever present and is taken care of in several ways. First, operators use only a high-grade oil and a minimum amount to do a proper lubricating job on the engine cylinders. Engine exhaust is taken through a baffle tank separator where it passes around three baffle plates while flowing from one end of the tank to the other. These baffles remove practically all water and oil from steam.

A close watch is also kept on the boiler gage glasses for any signs of oil. As a final precaution the boilers are inspected internally about every three months. The baffle tank has apparently been very effective, for no signs of oil have been found in the gage glasses or inside of the boilers.

Boiler Inspection

Boiler tubes are blown off once a day. Once each year, before the heating season, boilers are given a thorough cleaning and inspection inside and out and put into No. 1 condition. A careful check is also kept on furnace walls and baffle conditions to spot leaks.

Fuel oil is stored in two 18,500-gal tanks equipped with steam-heating coils around the pump suction pipes. After being pumped through the heaters, where temperature is increased to 180 F, the oil is metered to each boiler as fired. The boilers also have steam flowmeters, a feedwater venturi meter, feedwater-temperature recorder, CO_2 recorder, a smoke detector installed in the breeching to the stack, stack-temperature recorder, and a boiler-load indicator. These meters provide operators with the necessary information to keep a close check on boiler operation.

Fuel-air ratio on the boilers is regulated to maintain 13% CO_2. This value has been found to be about the best. It is sufficiently high for good boiler and furnace efficiency, and yet on the safe side of conditions that might cause smoke. The smoke detector gives a continuous record of stack gas quality and sounds an alarm and lights a red light if smoke density approaches an objectionable color.

Engineers read the meters and record the readings in a log book at the end of each shift. This log book is turned in to the chief engineer's office where daily, weekly, monthly and yearly reports on plant performance are compiled. Daily performance figures check plant operation on each shift and if anything unusual develops it is immediately detected and remedied.

From the daily reports monthly

quantities and averages are computed and then charted, see Fig. 2. This record gives a comprehensive picture of plant load and performance. Across the top of the chart, evaporation per pound of fuel is given, which averages about 14.5 lb. This figure is probably low, as the method used to compute it is a little unfavorable to the boilers. A careful check, taking into account all factors, shows that the evaporation is nearly 15 lb, but the management wants to stay on the safe side. The consistency of these figures indicates the plant is being well maintained and operated.

Check on Fuel Oil

The second line across the chart gives the average CO_2 and the third line the average outside monthly temperature. The latter is important in comparing monthly oil consumptions. In order down the chart are given the fuel oil consumed in pounds and in gallons at 60 F and consumed in gallons at 180 F. The latter is the meter figure which is converted into gallons at 60 F.

Below the record of fuel-oil burned, oil received in gallons and pounds is given, followed by the pounds of steam generated. This is the sum of the steam flowmeter readings from the boilers. At the bottom of the chart are given kwhr generated. On the right-hand side of the chart, space is provided for recording total quantities and oil costs. Last year 1,165,683 gal of oil were burned to provide 135,895,000 lb of steam and 1,454,710 kwhr.

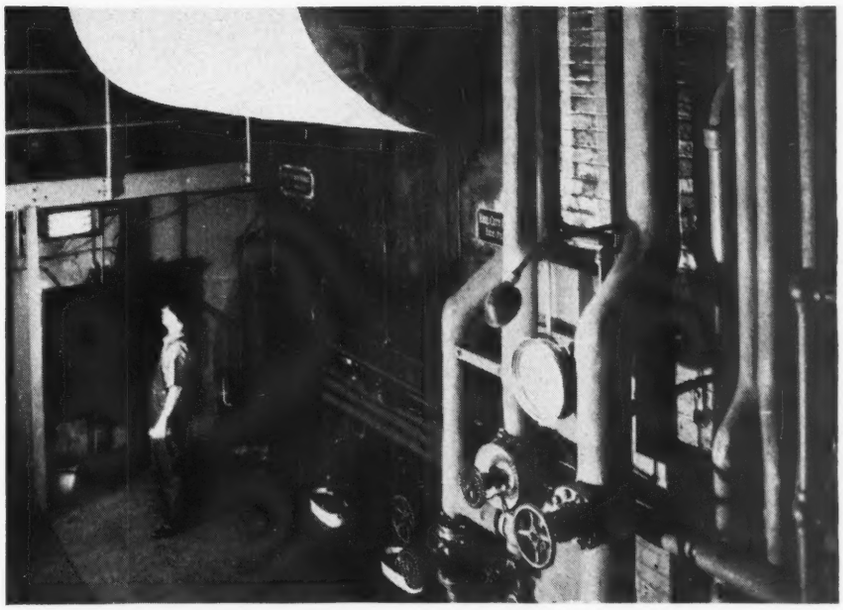


Fig. 3—New 5000-sq-ft boiler is oil fired by three burners under low end of boiler

Each month a report, giving quantities consumed and produced and the cost of fuel oil used during the month, is presented to the hospital director. This report compares similar quantities for the same month in the previous year and explains the differences.

Operators make every effort to obtain good over-all efficiency and at the same time favor the equipment where possible. Both boiler and generating units are conservatively loaded, even though this may result in a slight reduction of efficiency. The additional safety factor is considered to be well worth any apparent small increase in operating cost, which is probably more than saved in other ways. In a hospital, service must be as nearly 100% reliable as possible, and the plant is operated with this as a major objective.

POWER is indebted to Albin Johnson, chief engineer, Samuel Jones, senior engineer, and Charles J Mason, engineering assistant, for their assistance in preparing this article.

NEW POWER-PLANT EQUIPMENT

St Lukes Hospital, New York, N. Y.

Steam-Generating Equipment:

Boiler, cross drum.....Erie City Iron Works
Heating surface, 5000 sq ft; rated continuous max steaming capacity, 30,000 lb per hr; design pressure 250 lb per sq in.; operating pressure, 150 lb per sq in.; total steam temperature, saturated; effective furnace volume, 1400 cu ft; Btu liberated per cu ft of effective furnace at max rating, 25,000.
Boiler heat insulation.....Johns-Manville Co
Soot blowers.....Vulcan Soot-Blower Co
Gage columns.....Reliance Gauge Column Co
Oil burners, 3.....B P Lientz Co
Blowoff valves.....Everlasting Valve Co
Safety valves.....Ashton Valve Co
Stop valves.....Ashton Valve Co
Non-return valves.....Ashton Valve Co
Reducing valves.....Foster Engineering Co
Piping contractor.....Alford & Swift Co
Pipe heat insulation.....Johns-Manville Co
Feedwater heater.....Worthington Pump & Machinery Corp
Feedwater treatment.....G W Gallaway

Pumps:

Feed pumps, direct acting, 2.....Worthington Pump & Machinery Corp
Feed-pump governors.....Fisher Governor Co
Condensate-return pumps, direct acting, 2..Worthington Pump & Machinery Corp
House pumps, centrifugal, 2.....Economy Pumping Machinery Co
House-pump motors.....General Electric Co
House-pump-motor controls.....Cutler-Hammer, Inc
House pumps, direct acting, 3.....Worthington Pump & Machinery Corp
Sump pump, direct acting, 1.....Worthington Pump & Machinery Corp
Sump pump, centrifugal, 1.....Dayton-Dowd Co
Sump pump, centrifugal, 1.....Economy Pumping Machinery Co
Sump-pump motors.....General Electric Co
Sump-pump-motor controls.....Cutler-Hammer, Inc
Vacuum pumps, 2.....Skidmore Corp
Vacuum-pump motors.....Westinghouse Elect & Mfg Co
Vacuum-Pump-motor controls.....Cutler-Hammer, Inc
Ejector controls.....Cutler-Hammer, Inc
Lubricators on steam pumps.....McCord Radiator & Mfg Co

Meters and Instruments:

Steam flowmeters.....Republic Flow Meters Co
Steam-flow recorders.....Republic Flow Meters Co
Feedwater flowmeter.....Builders Iron Foundry
Steam-pressure and temperature recorders.....Bristol Co
CO_2 recorder.....Republic Flow Meters Co
Oil-pressure gages.....Manning, Maxwell & Moore, Inc
Oil flowmeters.....Buffalo Meters Co
Draft gages, 2 point.....Republic Flow Meters Co
Boiler-load indicator.....Republic Flow Meters Co
Smoke detector and recorder.....Ess Instrument Co
Steam pressure gage.....Manning, Maxwell & Moore, Inc
Watthour meters.....Sangamo Electric Co
Recording voltmeter.....Bristol Co
Recording ammeter.....Roller-Smith Co
Ammeters, indicating.....Weston Electrical Instrument Co
Voltmeters, indicating.....Weston Electrical Instrument Co

Power-Generating Equipment:

Engines, 2, Lentz poppet valve.....Erie City Iron Works
One 15x18 in., 225 hp, 257 rpm, and one 17x21 in., 300 hp, 225 rpm
Generators.....Crocker-Wheeler Electric Mfg Co
One 150-kw and one 200-kw, direct-connected, 3-wire, 120-and 240-volt
Engine-oil centrifuges.....De Laval Separator Co
Engine lubricators.....Torrington Mfg C
Atmospheric relief valve.....Cochrane Corp
Steam separators.....Wright-Austin Co
Exhaust-steam oil separator.....Cochrane Corp
Switchboard.....Royal Switchboard Co
Circuit breakers.....ITE Circuit Breaker Co
Automatic transfer switch.....Automatic Switch Co
Ventilating fans in boiler room, 2.....American Blower Co
Air filter.....American Air Filter Co
Fan motors.....General Electric Co
Fan motor controls.....Cutler-Hammer, Inc
Air compressor.....Worthington Pump & Machinery Corp
Consulting engineers.....Syska & Hennessy
Builders.....Marc Eidlitz Co

ABC'S OF DRAFT

By WILLIAM H PUGSLEY
Manager of Engineering, The Hays Corp

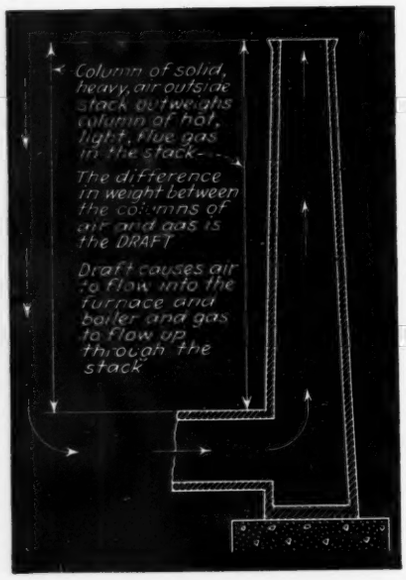

Column of solid, heavy, air outside stack outweighs column of hot, light, flue gas in the stack
The difference in weight between the columns of air and gas is the DRAFT
Draft causes air to flow into the furnace and boiler and gas to flow up through the stack

Fig. 1—Draft is the difference in pressure caused by difference in temperature, and therefore in weight, of two vertical columns of gas or air

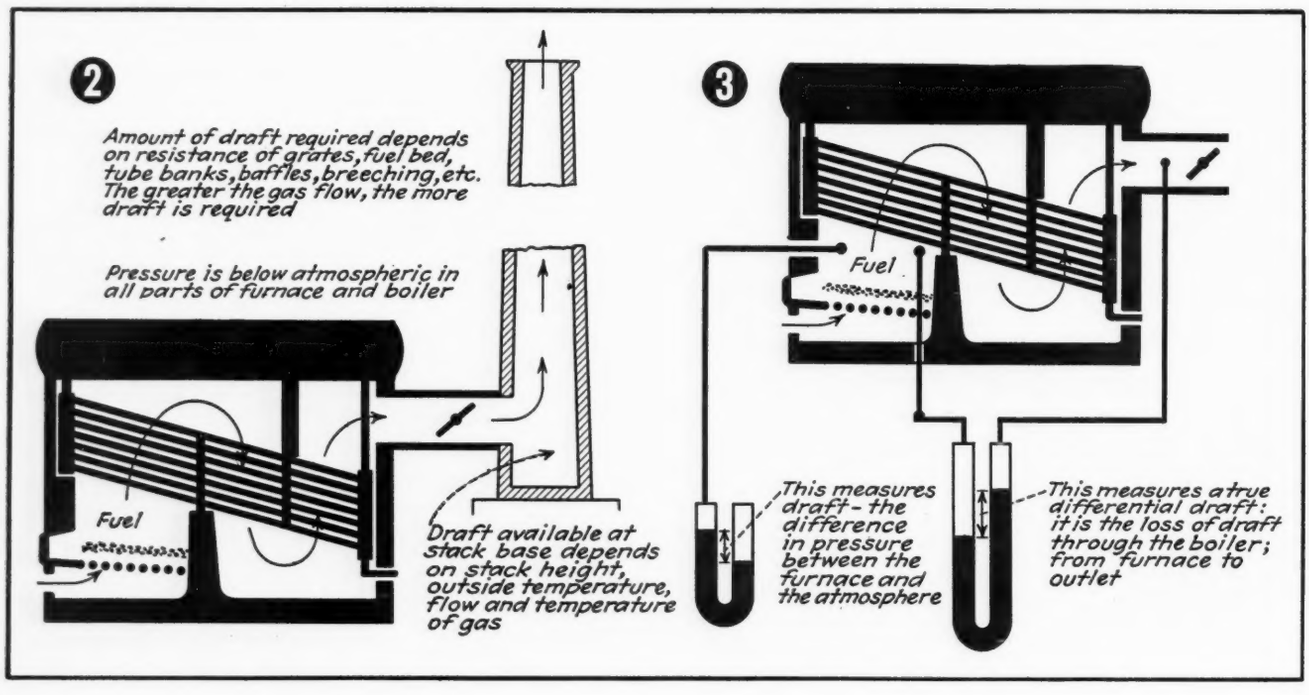
Draft plays a big part in boiler-room efficiency—every operator should know exactly what it is, what it does, how and where it's measured. Here's the first of a series that answers these questions and a few more

DRAFT IS ONE of those words we all use freely without always being exactly sure what we mean. When referred to in connection with combustion in a boiler or furnace, draft means a *static force* similar to the pressure of water in a pipe or the voltage between two wires of an electric circuit. Draft *does not mean* the *movement* of air or gas but rather the *force* which *causes* the movement. To be even more scientific, we define draft as the difference in pressure caused by the difference of temperature, and therefore weight, of two vertical columns of gas or air.

We use draft in the combustion process to cause air to flow into contact with the fuel to be burned and also to take away the gas produced by combustion. The amount of draft, or difference in pressure, required depends on how much resistance there is to the flow of air and gas. Installation of superheaters, economizers, air heaters, dust collectors, or long and complicated breechings means need for more draft. If the pressure difference is greater than can be obtained naturally, we have to install mechanical draft.

Draft is always referred to as being below atmospheric pressure and is therefore *negative pressure*. Pressure above atmospheric is called *positive pressure*, although often carelessly spoken of as "draft."

Fig. 2—Natural draft: Stack creates pressure difference needed to bring air in contact with fuel and to remove products of combustion. Fig. 3—Draft, the pressure difference between a point and the atmosphere, should not be confused with differential draft, the difference in draft between two points


2
Amount of draft required depends on resistance of grates, fuel bed, tube banks, baffles, breeching, etc. The greater the gas flow, the more draft is required
Pressure is below atmospheric in all parts of furnace and boiler
Fuel
Draft available at stack base depends on stack height, outside temperature, flow and temperature of gas
3
Fuel
This measures draft - the difference in pressure between the furnace and the atmosphere
This measures a true differential draft: it is the loss of draft through the boiler; from furnace to outlet

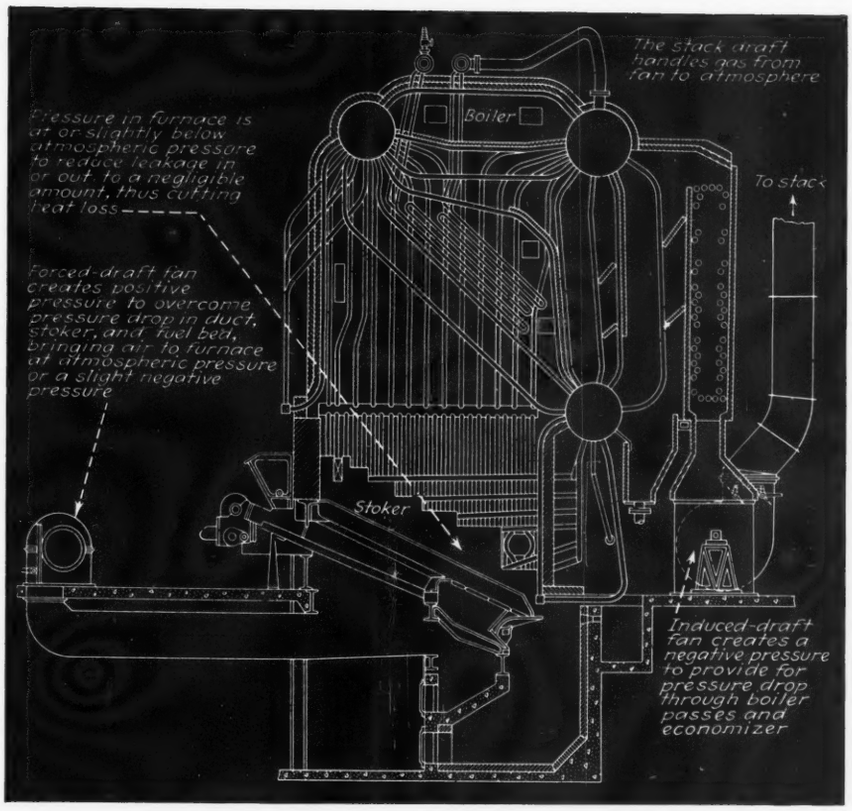

The stack draft handles gas from fan to atmosphere
Boiler
To stack
Pressure in furnace is at or slightly below atmospheric pressure to reduce leakage in or out to a negligible amount, thus cutting heat loss
Forced-draft fan creates positive pressure to overcome pressure drop in duct, stoker, and fuel bed, bringing air to furnace at atmospheric pressure or a slight negative pressure
Stoker
Induced-draft fan creates a negative pressure to provide for pressure drop through boiler passes and economizer

Fig. 4—Mechanical draft: Forced-draft fan brings air to and through fuel bed; induced-draft fan removes products of combustion from furnace

Natural draft means the draft created by the use of a chimney or stack. The combustion gas inside of the stack (Fig. 1) are hotter and therefore lighter in weight per cu ft than the outside atmosphere; the difference in weight produces a difference in pressure, or a draft, which, in turn, causes cold outside air to enter the furnace and hot gas to flow up the stack. The amount of draft, measured at the base of the stack, depends on the height of the stack, the temperature of the gases within it, and the temperature of the outside air (Fig. 2). Wind will sometimes affect the draft of a stack but for all practical purposes it is not considered because of its varying affects. The location above sea level also affects the amount of draft available from any given stack height because the higher the stack is above sea level, the less outside air will weigh in relation to gas in the stack.

Mechanical Draft

Mechanical draft means draft or pressure difference created by means of fans or blowers. Mechanical draft falls into two divisions: *forced* draft and *induced* draft. In *forced* draft, the fans create a pressure above atmospheric which, properly speaking, is a *positive pressure* and not a *draft* at all. The pressure is used to force air through ductwork, dampers, air heaters, fuel-burning equipment and, in the case of fuel burned on grates, through the fuel bed (Fig. 4).

Induced draft, a suction action below atmospheric pressure, is a real *draft*. Fans or blowers handle the job when it wouldn't be economical to install a stack high enough to provide the needed draft. In most cases where induced draft is used, only enough stack is installed to discharge gas at a sufficient height to prevent nuisance.

Furnace Pressure

In the usual case, pressure at the outlet of the forced-draft fan is above atmospheric, pressure in the furnace over the fuel bed is just atmospheric or slight below, and pressure at the inlet of the induced-draft fan is under atmospheric. The pressure drop between the forced-draft-fan outlet and the furnace carries the air through the ductwork, windbox and fuel bed, while the pressure drop from the furnace to the induced-draft-fan inlet carries gas through the boiler, economizer, breeching, etc. When furnace pressure is just about atmospheric, or a shade below, it is called *balanced draft*. The advantage of such operation lies in the fact that furnace pressure and pressure outside are so nearly the same that there is no appreciable leakage into the furnace or out of the furnace. Either kind of leakage means heat loss and inefficiency.

Theoretical draft is the amount which can be secured theoretically under a particular condition of air temperature, gas temperature, barometric pressure, and stack height. Because the flow of gas up the stack causes friction and a pressure drop, the theoretical draft is never obtained in practice. *Available draft* (Fig. 2) is the draft that can be obtained with a flow of gas in the system; it decreases as the gas flow increases. If we add up all the losses or pressure drops in the path taken by air and gas through fuel-burning equipment, boiler, economizer, breeching, etc, we get the *required draft*. Since the losses depend on how much air or gas is flowing, the required draft varies the same way; more air or gas flow means more required draft. Checking the required draft against the available draft indicates what air and gas flows can be obtained and thus what boiler ratings can be carried.

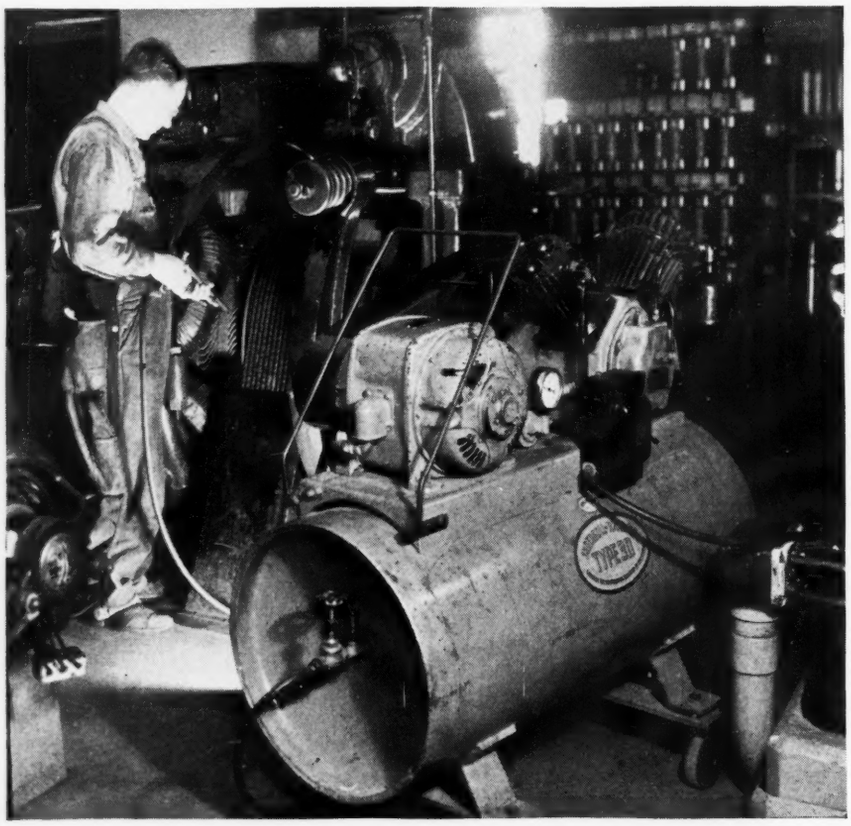
Stack effect or *chimney action* refers to the tendency for heated gas to rise in the passes of a boiler. When the normal flow of gas in the pass of a boiler is upward, the stack effect helps to reduce draft loss in this pass and when flow of gas is downward in the pass it adds to the draft loss in that pass. When using draft loss across a boiler pass to measure gas flow, compensate for this action so as to obtain as true a relation between flow and pressure drop as possible.

Differential Draft

Differential draft refers to the difference between draft measurements taken simultaneously, at two different points of the furnace, boiler, or steam generator. This differential measurement (Fig. 3) is sometimes referred to as *draft loss* as it represents the loss in draft due to friction of the gases passing through restrictions such as baffles, tube banks, etc. *Differential pressure* refers to the difference between pressure measurements taken simultaneously in the same system at two different points. It shows the loss in pressure between the two points due to flow.

The word *differential* is sometimes used with the word *draft* or *pressure* when referring to a single draft or pressure measurement (Fig. 3), and its relation to atmospheric pressure. This use of the word, although all right on paper, leads to confusion because the use of the words *draft* or *pressure* alone is commonly understood to refer to the relationship of the measurement taken and the existing atmospheric pressure.

PRACTICAL AIDS TO OPERATION



Compressed Air Aids Maintenance

COMPRESSED AIR is a convenient medium for doing a lot of maintenance jobs. We use it for blowing dirt out of equipment, spraying insulating varnish onto electrical-machinery windings, and for other purposes. To provide this air we use a portable unit consisting of a motor-driven air-cooled compressor mounted directly on a storage tank, supported on four rubber-tired wheels. The compressor is rated 10 cfm and 80 lb.

The air storage tank, which is the widest part of the unit, is only 15 in. in diameter. Its narrow width permits taking the unit most anywhere in the building where compressed air is needed. The photo shows the compressor in one of our elevator rooms being used to blow dirt out of the windings of one of the main motors.

New York, N. Y. F G RECHBERGER
Elevator Engineer, Empire State Bldg

Wound-Rotor Motors Changed to Squirrel-Cage

IN OUT-OF-THE-WAY PLACES the sky is the limit in getting a job going. When I was in a remote mining camp, several wound-rotor induction motors were burned in a fire. We had wire available with which to rewind the stators, but not the rotors which had the starting resistors mounted inside. To simplify the repair problem we decided to put squirrel-cage windings on the rotors.

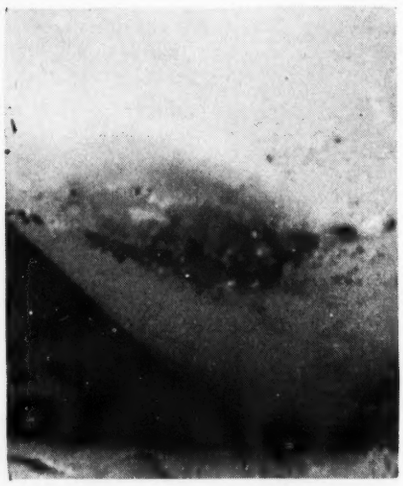
First we removed the copper bars from the old windings and cut them about 6 in. longer than the length of the rotor slots. After tinning the ends of these bars, one was placed on its edge in each slot. Then their overhanging ends were bent to form a continuous ring, after which the ends were wrapped with copper wire to hold them together.

The bars only about half filled the slots, so we placed each rotor on end, wrapped its core with a sheet-iron plate and clamped it tightly in place. This closed the outer slot openings. At the bottom of the core we closed the slots with clay and poured each full of babbitt. Rings of the same metal were also formed around the end of the bars and when the rotor had cooled all excess metal was removed in a lathe to make a good neat job. Believe it or not, the motors worked fairly satisfactorily, except that their starting torque was not quite as good as might be desired. This may have been hit-or-miss motor design, but we got the plant going again with minimum delay.

Philadelphia, Pa. R O SPENCER

Causes of Cracks in Boiler Shell Plates

A QUESTION sometimes asked is: Can overheating a boiler result in cracking? The answer is, with a cast-iron boiler,



cracking is quite likely. With a steel boiler, cracking is not common.

Parts of a steel boiler, if subjected to overheating, usually bulge and may rupture at the apex of the bulge, see photo. However, if the part overheated is held rigid by constructional details, bulging may not be possible. Then, continued exposure to excessive temperature may burn the metal, resulting in a crack. Actually, as the steel is heated above the critical temperature, grain growth occurs. The binder (austenite) between the grains has a lower melting point than that of the grains, and the austenite fuses if the temperature goes high enough. On cooling, this fusion

between the grain structure appears as a crack.

The knuckle (turn of a flange) of a head may be quite close to a riveted seam. If so, the plate is extremely rigid. At such a place one might reasonably expect that extreme overheating would result in a crack and not a bulge. If scale is permitted to accumulate in this location cracking is likely to occur from overheating of the metal.

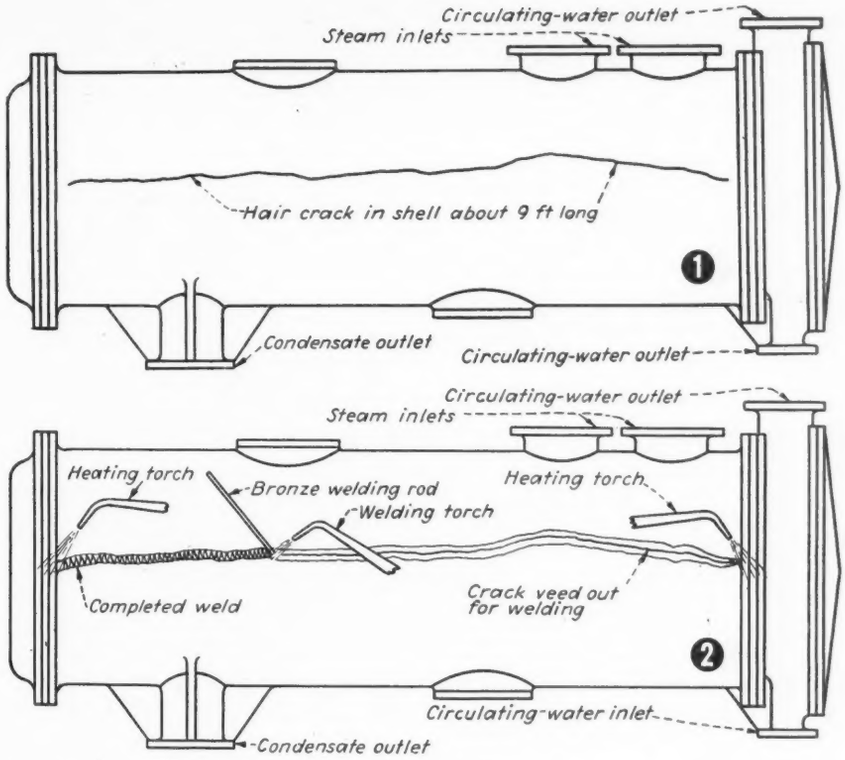
Cleveland, Ohio A C WIGGINS

Bronze Welding Repairs Condenser

STARTING a piston circulating-water pump without first opening the outlet valve on the condenser caused the shell of the latter to crack from excess pressure, Fig. 1. To obtain a speedy repair, we decided to bronze-weld the shell.

First, tubes were removed and heads replaced on the shell. Then, the crack was veed out by chipping, care being taken to keep the bottom of the crack closed as nearly as possible. Steam was then turned into the condenser and the shell gradually preheated with low-pressure steam for 5 hours before starting oxy-acetylene welding.

Three torches were used, see Fig. 2, while making the repair. Two of them were used for heating the flanges, while the third welded the crack closed. Preheating by steam was continued until all welding was completed, after which steam was gradually shut off and the shell allowed to cool slowly. After the shell cooled the tubes were replaced and the unit put into service. During 18 months of practically continuous operation under a 28-in. vacuum the shell has not showed any indication of a leaking at the crack, which speaks well for the welding job.



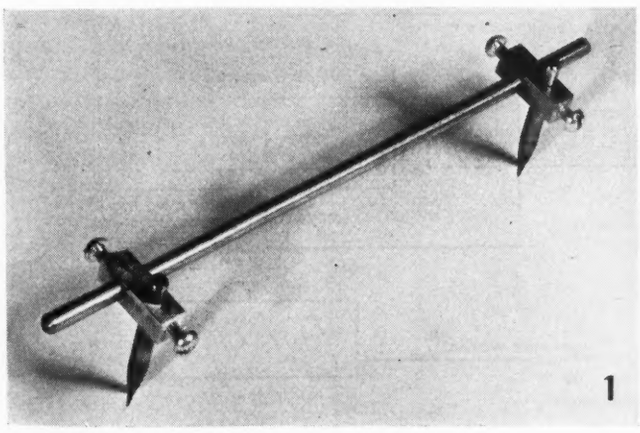
Preheating cast-iron pressure vessels with steam prior to welding has not been used very extensively in industry, but is frequently applied in the oil fields, because of its time- and trouble-saving features.

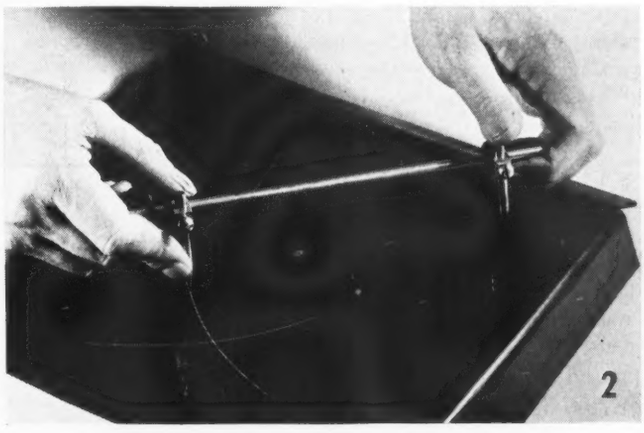
Kansas City, Mo. T B JEFFERSON

Many-Purpose Beam Compass

THE COMBINATION BEAM COMPASS shown in the photos has many plant applications. For example, it can be used to lay out sheet-metal work, Fig. 2, to check gage points on engines and other machines, to transfer measurements accurately from scale to object, or the reverse. No particular originality can be claimed for the design of the beam compass, Fig. 1. It is, however, rigid, practical and very easy to make. While the trammel points are best turned and ground in a lathe, you can do a fairly good job on an ordinary bench grinder.

Make these points of ¼-in. drill rod. Grind, while soft, to a sharp point. Heat to a cherry red and quench. Then brighten with fine emery cloth and heat the butt end until the temper at the point draws to a light straw color. Use wheel or oilstone to give the point a final light touch up to needle sharpness. The point holders may be made





of square or round rod (brass or soft steel).

Set screws shown are 10-24, round head. Knurled or wing heads would avoid using a screw driver to set. For the beam use ordinary ¼-in. soft-steel rod, ends rounded. It is convenient to have three rods of different lengths—say, 10-, 20- and 30-in. For the occasional very big job you can borrow a long rod from the stock rack to scribe an arc many feet in radius.

Philadelphia, Pa. R O SPENCER

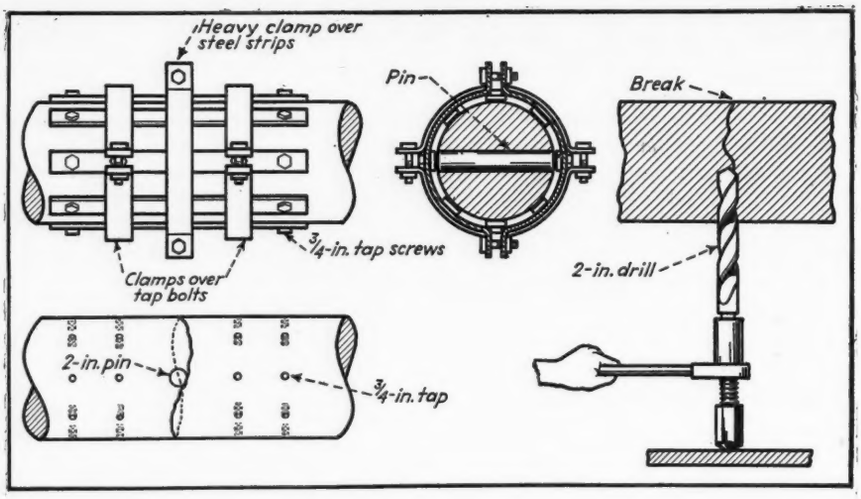
Light Crane Tops Guy-Line Anchorage

A SECTION of extra-heavy 10-in. pipe, used to elevate stack guys above the plant yard, was also made to serve as a mast for a light crane. Inside the 10-in. pipe two disks were welded, one at the top, the other 3 ft down. Holes cut within these disks prior to welding permit a section of extra-heavy 2-in.

pipe to stand within them, the upper disk serving also as thrust bearing for a ring welded on the 2-in. pipe to prevent its dropping too far into the anchorage.

A horizontal arm, strengthened with a tension rod to the top of the 2-in. pipe (see photo) supports a loop into which can be hooked a snatch block. One man with the crane can handle loads onto trucks which would otherwise require the assistance of a second man. The crane also removes much of the hazard from lifting heavy objects.

Longview, Texas ELTON STERRETT



Ingenious Repair on Large Shaft

MANY AND INGENIOUS are the emergency repairs that have been made on ships to get them into port. Here is one on a broken 10-in. shaft. A hole was drilled through the shaft at the break for a pin to act as a key to take the torsional load. Eight steel straps were then fastened to the shaft with tap bolts to prevent the break opening.

Clamps placed over two rows of the tap bolts prevented them from working loose and a heavy central clamp added stiffness to the job. This repair brought us into port, but at greatly reduced speed in order to lessen the torsional load on the shaft and prevent the key shearing.

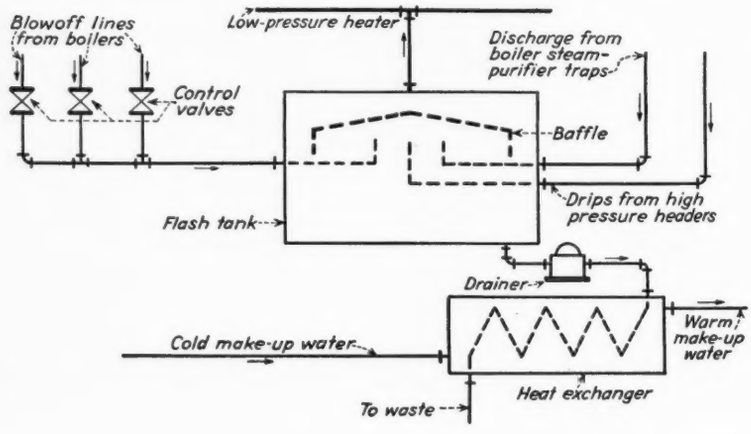
New York, N. Y. S M ELONKA

All High-Pressure Drips Drain Into One Tank

RECOVERY OF HEAT from high-pressure drips presents a number of design problems. Experience has shown that returning high-pressure, high-temperature water directly to low-pressure heaters is inadvisable. Safety of personnel and equipment is frequently endangered by the possibility of structural failures caused by over pressure, steam hammer or the effect of expansion strains. Piping these drips directly to surge tanks open to the atmosphere wastes flash steam and causes excessive vibration and noise.

These limitations are commonly overcome by a flash tank between the drip source and the heater. Such a tank, vented to a low-pressure steam header, and provided with a trap on its low-pressure side, reduces both pressure and temperature with only a small loss of heat. In our plant we use the continuous-blowoff-system heat-recovery equipment for this purpose, as in the figure. Drips from high-pressure steam lines and water from boiler-steam-purifier dischargers are piped to the blowoff flash tank. Residual heat in the liquid is then recovered in the heat exchanger, after which the drips go to the sewer along with the cooled blowdown water.

Drips from both steam headers and purifiers ordinarily contain a high per-

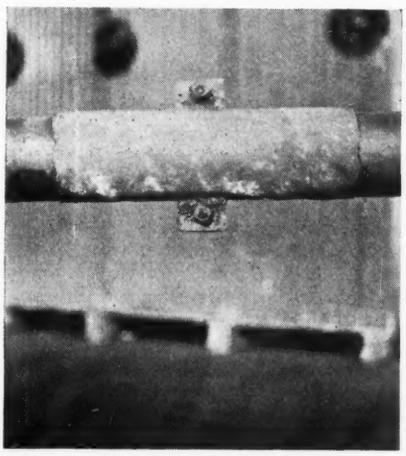


centage of solids that have been carried over from the boilers. Therefore, this method of disposal does not waste condensate as might be supposed, but prevents increasing the impurity content of the feedwater that would occur if these drips were allowed to enter the heater or surge tank.

Bethesda, Md. S H COLEMAN

Shields Prevent Soot-Blower Erosion

WE HAVE A STRAIGHT WATER-TUBE BOILER with rotating soot blowers. Since this boiler has closely staggered tubes it is impossible to adjust the blower so that it will not impinge on the tubes at some part of its travel. This eroded



some of the tubes so badly that we had to have them replaced. By using shields like that shown in the photo we have been able to prevent this erosion.

We make these shields by cutting a section of old boiler tube through the center and into pieces about 18 in. long, with an ear welded to each edge. A U-bolt clamp fastens each shield to its tube. When the shields become eroded we replace them at small cost.

In our boiler these shields are fairly well protected and we have had no trouble due to poor heat transfer between tube and shields. If the shields were placed on the lower row of tubes and exposed to high furnace temperatures, they might burn. This trouble can be reduced by having a good fit between tube and shield on clean surfaces.

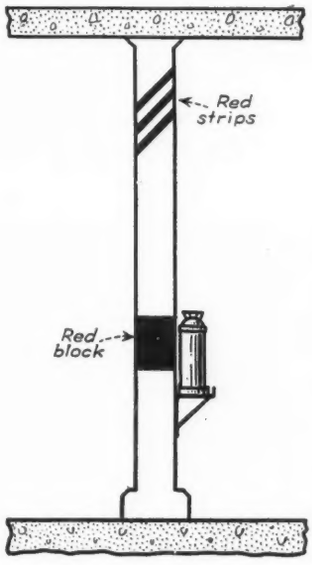
Harvey, S. D. ORVILLE HOKSCH

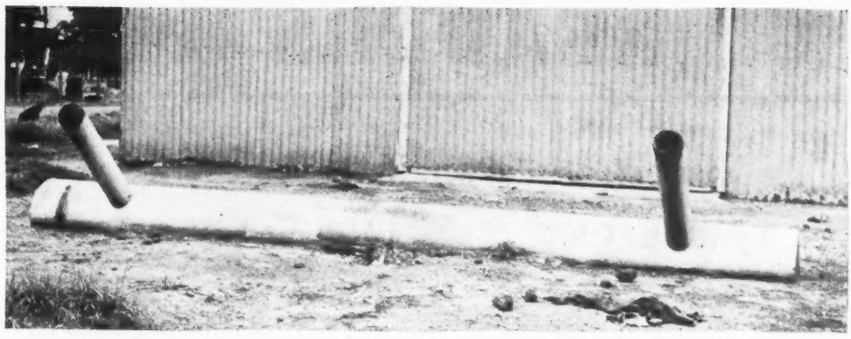
Where Is the Fire Extinguisher?

INSTRUCTIONS OF PLANT PERSONNEL concerning location of fire extinguishers are an important though frequently neglected duty of supervisors. If and when such instructions are given, they usually follow a fire or fire scare and are forgotten in a short while. Months, and perhaps years, may elapse before another occasion arises to call attention to the general lack of knowledge concerning extinguishers among employees.

To assist in finding fire-fighting equipment when it is needed, one large company paints red stripes on the four sides of columns or on walls where equipment is located (see figure). These stripes are placed high enough so that intervening machinery will not prevent their being seen.

Richmond, Va. C R ANDERSON



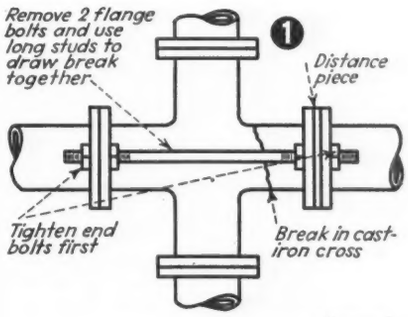


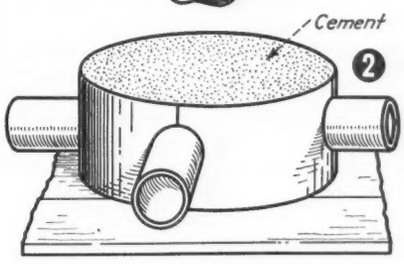
Dual Outlet Reduces Engine-Exhaust Noise

REDUCING EXHAUST NOISE from engines is often necessary when they operate in a built-up community. We made an ingenious design to take advantage of both expansion and wave interference for quieting gas-engine exhaust. In the middle of a 16-ft length of 14-in. pipe we welded in the 4-in. exhaust line from the engine. About 2 ft from each of the two closed ends of the big pipe we welded a 4-ft stub of 4-in. pipe, set at an angle of about 45 deg with the ground, see the photo.

Exhaust impulses reaching the big pipe expand, divide and are carried through it to the ends, where they are reflected and cushioned by the dead gases. After being slowed down, the reduced impulses find their way to the outside through the twin exhausts with the noise considerably reduced.

Kilgore, Texas C C LYNDE


Remove 2 flange bolts and use long studs to draw break together
1
Distance piece
Tighten end bolts first
Break in cast-iron cross



Concrete Repair for Pipe Fitting

A DOUBLE-TEE FITTING broke in a large cast-iron pipe, as shown in the figure, because of poor pipe alignment and vibration. A new fitting was not readily available so we had to make a repair. We made a distance piece to separate two of the flanges and close the crack. Then, with two long threaded rods we pulled the crack tightly closed.

By building a form around the double tee and pouring it full of concrete, we sealed the crack, Fig. 2.

New York, N. Y. S M ELONKA

READERS' PROBLEMS

Questions from Our Readers

Two Belts OK?

Question 1

WE HAVE A TROUBLESOME BELT DRIVE *consisting of a 90-in. diameter pulley driving a 20-in. diameter pulley through a 24-in. double leather belt with pulleys on 21-ft centers (approx). To transmit the maximum load of about 135 hp, it is necessary to keep the belt extremely tight, which, we believe, causes the two plies of the belt to come apart continually. One of our operators claims that the difficulty could be overcome by running a second belt outside of the one now in use, keeping the outside belt reasonably tight and the inner belt slack. In theory, the outside belt would make the inner belt grip the pulley better and thus pull most of the load. Would this work satisfactorily?*—JTZ

Airbound Water Line

Question 2

A 2-IN. PIPE *about 1000 ft long supplies our plant with water for drinking and for washing out boilers. After washing out a boiler, the line often becomes airbound and it takes some time to reestablish flow. The source is a small reservoir kept filled by a spring which is about 50 ft higher than the boiler house floor. There is a crest in the pipeline about 12 ft lower than the water level in the reservoir. What causes the pipe line to become airbound and how can we cure it?*—PSW

SUITABLE answers from readers will be paid for if space is available for publication. Answers accompanied by practical drawings or photographs will command additional pay.

Diesel Rings Break

Answers to June Question 1

The Question

IN OUR 2-CYL, *2-cycle, 257-rpm, 100-hp semi-diesel, the piston rings persist in "snapping" even immediately after rings and pistons have been cleaned. We have had no lubrication troubles and almost no ring sticking in 4000 hours of operation. Breakage of the rings occurs only at the ends where they are pinned to prevent turning on the piston. The snapping noise seems to come from the same cause as the breaking of the ring ends. There is no sign of excessive wear either on ring seats or cylinder walls. Can some* POWER *reader suggest a reason for this difficulty* —TSA

Minus Circularity

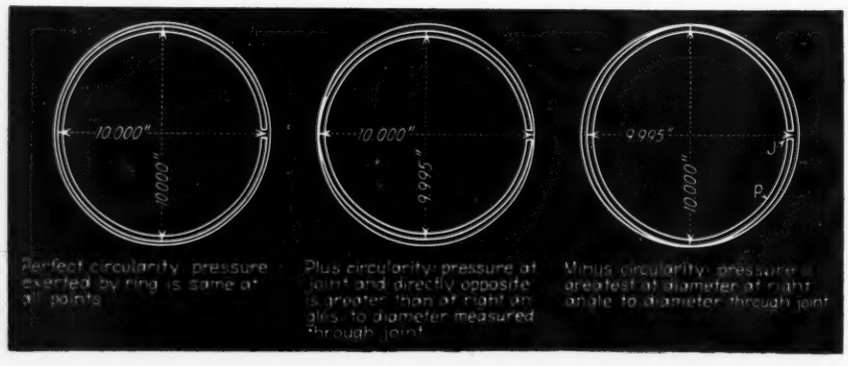
SNAPPING, SLAPPING OR FLUTTERING of piston rings, sometimes resulting in breakage, is often caused by minus circularity. Breakage unaccompanied by snapping may be due to ring sticking, insufficient joint clearance, or to extreme plus circularity.

Plus or minus circularity exists when a ring is not perfectly circular when compressed within the cylinder, but has a larger diameter or exerts a greater pressure across one diameter than another (see sketch). The effects of plus or minus circularity are much the same as when a ring having perfect circularity operates in an out-of-round cylinder. If a new ring slaps shortly after being installed in a perfectly round cylinder, it may merely lack tension but the chances are that minus circularity is the cause.

To check circularity, wrap a piece of thin, previously miked, sheet metal about the ring and draw the rings and strap together until feeler gages show the joint to have the same opening as when the ring is in position in the cylinder. If the diameter measured from the joint to a point opposite is greater than at 90 deg to the first diameter, greater pressure will be exerted at this first diameter when the ring is installed and the ring will be plus circular. If the shorter diameter runs through the joint, the ring is minus circular. The ends of the ring will be free or press only slightly against the cylinder wall and tend to flutter or snap with each reversal of the piston stroke. If rings are pinned at a short distance from the ends, the continuous fluttering will cause them to break, even though there is little play between the sides of the ring and the lands of the ring groove.

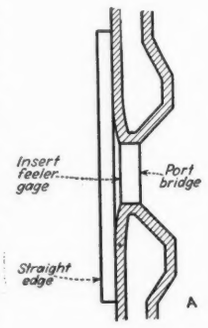
If a ring has high tension, perfect circularity is desirable. For low or medium tension rings, plus circularity is essential. Where minus circularity exists or where out-of-roundness creates a condition similar to minus circularity, rings should be pinned only at the joint and not at a short distance from the ends. Since the diameter of a worn cylinder will be elongated at right angles to the crankshaft; a minus circular ring, if used, should be pinned with the joint parallel to the shaft.

Marissa, Ill. GEORGE BLUM


10.000"
10.000"
10.000"
9.995"
9.995"
10.000"
J
P
Perfect circularity: pressure exerted by ring is same at all points
Plus circularity: pressure at joint and directly opposite is greater than at right angles to diameter measured through joint
Minus circularity: pressure is greatest at diameter at right angle to diameter through joint

Port-Bridge Growth

THE MOST COMMON CAUSE of ring breakage in engines of TSA's type is port-bridge growth. The port bridges have a tendency to push out towards the piston, decreasing ring-end clearance until finally the ring ends butt and break. It is common practice to relieve the port bridges. A 14-in. bore engine usually requires cutting back the port bridges about 0.004 to 0.008 in. This should be checked every time the pistons are pulled; the best method is to use a straight edge and feeler gage as shown in the sketch. Remember that too much relief is about as bad as too little, also that the relief should be gradual. The 0.004 to 0.008 in. of relief should extend 1 in. to 1½ in. above, below, and to the sides of the ports, and should taper back to normal cylinder bore in about 1 in. Be sure that no rough edges are present.

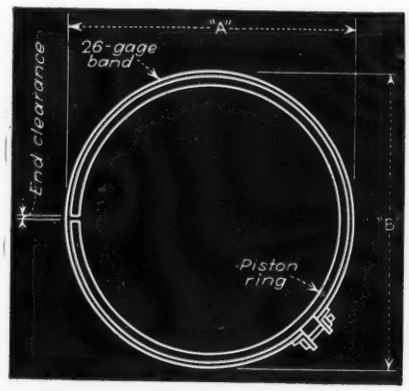


TSA should also check ring-end clearance. In 2-cycle service, 14-in. rings should have 0.08 to 0.09 in. gap, which should be checked in the unworn part of the cylinder. If breakage persists, I suggest that TSA remove the dowels. Use of rings having the outer diameter edges and ends rounded over is highly recommended where dowels are not used. Butt-cut ends are also suggested. Grooves should have no shoulder or worn edges and the ring should have proper side clearance, which in 14-in. bore is usually about 0.006 to 0.010 in. With proper care in taking them on and off the piston, ring breakage can be almost entirely eliminated if the above factors are thoroughly understood by the operator.

Chicago, Ill. C K FEYEN

Need Plus Circularity

THE USUAL CAUSE OF RING FLUTTER, the snapping noise referred to and breakage at the ends, is lack of plus circularity. A simple method of determining circularity is to place a ring in a flexible band of thin sheet iron, as shown in the sketch. The joint should be drawn up to leave a space equivalent to normal end clearance, usually 0.004 or 0.005 in. per in. of ring diameter, for small diesels. If dimension *A*



exceeds *B*, the ring has plus circularity and the ends will bear firmly against the cylinder walls. On the contrary, if *B* is greater than *A*, the ring has minus circularity and will cause vibration, crystallization, and breakage of ring ends.

Other causes contributing to ring breakage are poor quality or defective metal, insufficient end clearance which does not allow for expansion under maximum load conditions, and excessive wall thickness which distorts the ring when sprung over the piston.

Fresno, Calif. E H CARLSON

Try Removing Pins

THE SNAPPING AND BREAKING of the piston rings is probably due to pinning. In recent years, many operators have removed the pins which were previously used, and this has largely eliminated trouble. Sharp edges on the rings and ports will aggravate the difficulty. Therefore, ring edges should be rounded slightly and the ring joints should be well chamfered, the amount depending on the size of the rings. Care should be taken to see that the edges of the ports are also chamfered.

Insufficient end clearance may be another contributing factor, because, if the ends of the rings butt due to the heat of the engine, they may cause the rings to buckle and spring out into the ports. In order to make sure that the ring ends do not butt while in operation it is generally found necessary to use an end clearance of 0.006 to 0.008 in. per in. of diameter. Some makes of engines require larger clearances than others, but all 2-cycle engines are so hot when operating under load that it is necessary to have relatively large clearances.

TSA says there was *almost* no ring sticking. The word "almost" is significant because it must be remembered that the rings are far hotter in operation than when being examined. The heat might cause them to stick or at least to become sluggish in operation, although when they cooled off enough to be examined, almost all of them would be free. The best amount of side clearance to use depends on the size and make of the engine. Amounts varying from 0.006 to 0.012 are used successfully. In any case the upper rings should be fitted with more side clearance than the lower ones and ample clearances should be used on all rings to prevent any tendency toward sticking while in operation.

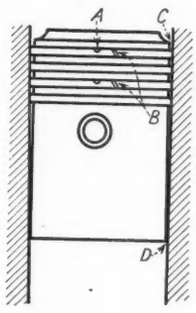
All of these points are important, but the removal of the pins is generally found to be the most important because it eliminates the weak section of the ring at the pinhole.

Baltimore, Md. E STEAD

Not Enough Clearance

TSA IS RIGHT when he assumes that the same thing causes the rings in his semi-diesel to make a snapping noise and also contributes to their breaking at the ends. The cause is insufficient clearance at the ends of the rings and at the pinholes, as at *A* and *B* in the sketch. It is safe to assume that the cylinder barrels on this diesel are somewhat worn at the top as shown at *C* but worn very little at the bottom, as shown at *D*.

Thus, as the piston is forced down to the bottom of the stroke, the rings are forced deeper into their grooves and if there is not enough clearance around the retaining pin or at the ring ends, the ring binds in the ring groove or on the pin. This prevents it from following the surface of the cylinder wall on the upstroke until the piston is near the top or to the point where the tension of the ring overcomes the force that holds it. When this point is reached, the ring lets go with a snap, making the noise TSA hears, and causing ring breakage, after a time. When this happens, the ring breaks where it is cut out to fit the retaining pin in the ring groove, as this is the weakest part of the ring.



On TSA's semi-diesel, with a piston diameter of 14 in., and a ring width of $\frac{3}{4}$ in., he should allow an end clearance of from 0.07 to 0.085 in. for the two lower rings and from 0.08 to 0.10 in. for the upper rings. Side clearance should be from 0.006 to 0.008 in. for the lower rings and from 0.008 to 0.010 in. for the upper rings. In this case it would probably be better to use the greater clearances given. It is also important to see that the clearance of the pinholes is a few thousandths more than the ring side clearance. TSA should also make sure that groove shoulders are true and that there are no burrs or spots that would hold the ring.

Bismarck, N. D. LESLIE BRADLEY

Try Increased Tension

AS TSA'S QUESTION involves no lubrication or ring-sticking troubles, his problem must be purely mechanical. His statement of the problem is general. It is impossible to tell whether all the rings on a particular piston snap or merely one. If the diesel is shut down when one ring breaks, is it always the same ring, and if so, which one? The following general remarks may help:

It is evident from the question that the ring clearances are at least sufficient. Perhaps some of the clearances are too great. Should this be the case, plus the fact that the rings are pinned, trouble might ensue under regular operating conditions. To be specific, vertical deflection of the rings during piston movement might be greater than safe deflection. As the groove could not supply sufficient cushioning effect, failure would have to occur. And this failure would occur at the point of pinning.

If the clearances are satisfactory (from 0.002 up to 0.0035 in. for the top ring) the problem may be one of ring "fluttering". Perhaps TSA is using low-tension rings. Such rings have low frequencies of vibration and, owing either to cylinder wall irregularities or to lateral piston movement, tend to vibrate at some engine speed. Vibration would cause the rings to snap—at the point of fixture first. This condition can be remedied by increasing ring tension. Of course, increasing ring tension increases the tendency of the ring to break through the oil film at lower speeds—particularly at the upper end of the stroke. A reasonable increase in ring tension, however, should not prove detrimental to the oil film.

New York, N. Y. BRIAN CORRIGAN

Making A Jet Pump

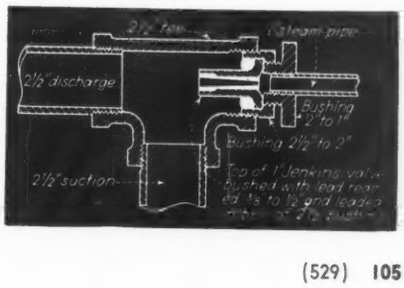
Answers to June Question 2

The Question

WE NEED *a small pump to lift water from an engine flywheel pit, and thought of making a steam-jet unit for the purpose. Have any* POWER *readers made such a device from fittings available around a power plant? We would like to get some suggestions.*—ESB

Good for 10-Ft Lift

THE SKETCH SHOWS A JET PUMP we have used on a suction lift of about 10 ft, discharging at about its own level. Steam pressure was about 75 lb, and operation

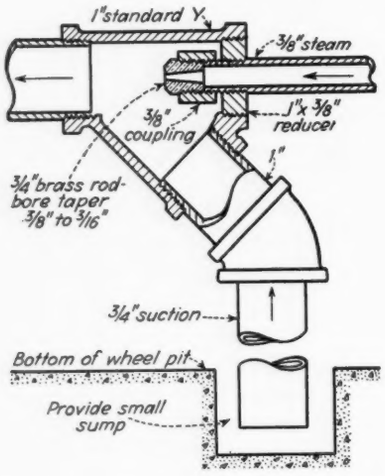


was highly satisfactory. I think any reasonable size pump can be made this way, using like proportions, out of standard pipe fittings and an improvised nozzle. This could be of brass or babbitt and fastened in the most practical way.

Leesville, S. C. F E Brodie

Use Brass Rod and "Y" Fitting

As it appears ESB is not in a position to spend any amount of money on this job, I suggest that he get a 1-in. standard "Y" fitting and a small piece of ¾-in. brass rod and make up the assembly shown in



the sketch. This type of pump is inefficient at best and the arrangement shown is not, of course, the best. An ejector suitable for this purpose lists at about $8.00 and if ESB can afford this small investment I think the "boughten" ejector would do a better job.

Bloomfield, N. J. J O G Gibbons

Use Reducing Tee

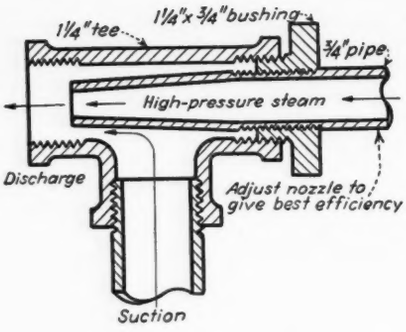
On page 771 of Power, December, 1939, there is a sketch of a simple gadget that would serve ESB's purpose, I think. I used this jet on the New York Aqueduct tunnel, making it from a reducing tee. ESB should size the tee according to the amount of water to be handled.

Riverdale-on-Hudson, N. Y. Alex Gray

Adjustable Nozzle

The sketch shows a jet pump I made from two pipe fittings and a short length of pipe. By heating and hammering the end of the pipe, I drew it out to a ⅜-in. nozzle, making sure it was perfectly round and smooth in the discharge end. The bushing, which is tapped, permits screwing the nozzle in or out to get the right suction. I used a 1¼-in. tee and bushed down to ¾ in. The jet pumps were connected to the ash pits under stoker-fired boilers and operated for years with good results.

A globe valve on the discharge pipe

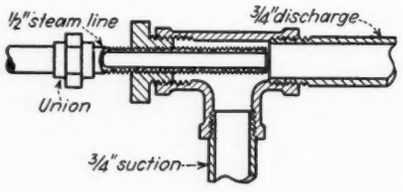


permits closing this line and by turning on the steam you can clean out the suction pipe in case it gets plugged. Incidentally, I made smaller jets like that in the sketch and used them to spray heavy black paint on boiler fronts, using compressed air in place of steam.

Chippewa Falls, Wis. A C Rindy

Made from Scrap

Some time ago we had a draft fan in a pit which kept filling with water. I made a jet like that shown in the sketch from parts found in a box of scrap. I took a ¾-in. tee and in one end put a bushing reducing to ½ in. I then threaded a ½-in. nipple for 3¼ in. and slightly tapered it on one end. This was screwed through the bushing until it reached the end of a ¾-in. pipe which had been slightly reamed and screwed into the other end of the tee. Into the third opening of the tee went the suction line, which had a strainer attached. I attached the ½-in. steam line with a union on the end of the



nipple, so by loosening the union I could screw the nipple in or out to get adjustment. This solved the problem at practically no cost.

Seattle, Wash. C A Taylor

Siphon for Short Job

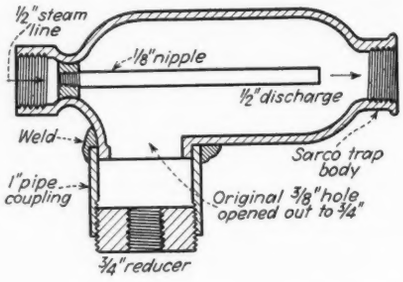
In our plant we have had considerable experience with steam jet pumps or siphons. We use them for pumping water from excavations, pits, and, in fact, every sort of low-lift pumping of a temporary nature. They are simple, easy to fit together, require no attention while pumping, and can be used anywhere provided a steam supply of 30 lb per sq in., or higher, is handy. One thing should be kept in mind, however. The steam-jet pump is very inefficient except where the heat introduced by the steam is used in the process, as with a boiler injector.

For any pumping use of a permanent nature, involving as low as 200 gal. per day, one of several automatic motor-driven sump pumps obtainable from electrical supply houses for around $30-$35 is to be recommended. These are driven by ¼-hp motors, are automatic, efficient and safe in operation. The steam-jet requires a tight-closing float valve to make it automatic. Further, anyone who passes by the discharge will receive a blast of scalding steam if the siphon should lose suction. For a cheap, easily fitted together, seldom-used pump, however, the steam jet is entirely satisfactory.

Port Arthur, Texas F F Axtell

Used Old Trap

We have had the same trouble as ESB and remedied it by using an old Sarco radiator trap, much the worse for wear. We took all the insides out, drilled and tapped the old discharge hole to ⅛ standard pipe size and screwed a piece of ⅛-in. standard pipe in place, using a rat-tail file tang to insert it. A 1-in. pipe coupling



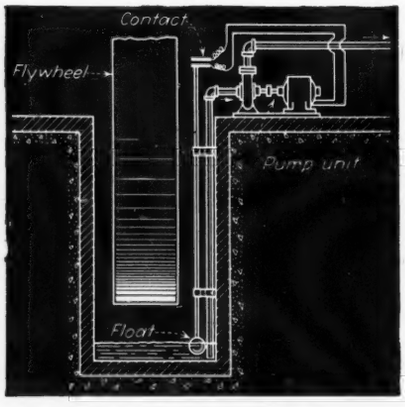
was welded on to make a suction side, after opening out the hole to ¾ in. The pump would not work at first, because no pipe was screwed on. Now, however, this little unit will empty a hole 10x4x3 ft, in 8 minutes.

Toronto, Ontario G H Hoyles

Use Centrifugal Pump

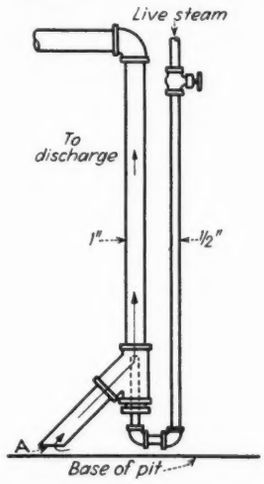
As water presumably collects in the flywheel pump during the night too, it will be advantageous to install a small automatic centrifugal pump driven by an electric motor. A float starts the pump, as shown in the sketch, as soon as the water level begins to rise. This arrangement calls for a larger investment but has the advantage of being completely automatic.

Vancouver, B. C. Alex Kaplan



Steam Siphon Works Well

I SUGGEST THE HOOKUP we used satisfactorily in a plant where I was employed. We employed live steam to siphon out the



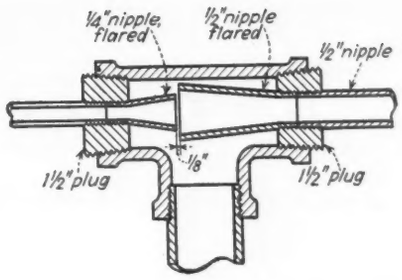
water. A ½-in. steam line is run into the base of a 1-in. "Y", with the steam nipple extending well into, but not beyond this "Y". If water in the pit is excessively hot it will be necessary to run in cold water to cool it down before the siphon will function. The siphon will work even when entirely submerged, removing water from point *A*. Although it is possible to purchase a ready-made siphon to replace the "Y", I think the homemade job works as well.

Worthington, Ohio W V KARN

Try Hand Pump

A STEAM-JET PUMP can be built from fittings ordinarily found in a scrap pile or purchased at a junk yard at reasonable cost. Theoretically, the jet will lift water about 30 ft but works better when the lift is not over 15 ft. No matter how well adapted to the job, a steam-jet pump is only about 20% efficient on account of unavoidable eddy currents. If used extensively for routine jobs as well as to handle accidental water leakage, the steam consumption would soon pay for a low-priced, portable, hand-operated barrel or rotary gear pump generally used for such purposes. Another advantage of a portable hand-operated pump is that it can be used anywhere around the plant and in many cases the water can be removed in less time than a jet can be connected to a steam supply.

Fresno, Calif. W C SOWELL



Need More Information

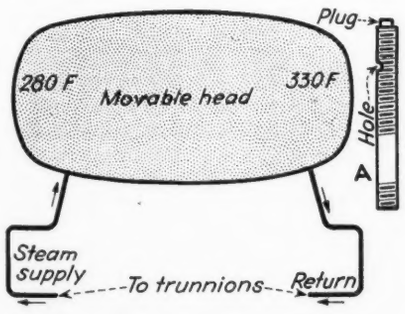
ESB GIVES LITTLE INFORMATION as to conditions under which his siphon will be operated. Depth of wheel pit, lift, steam pressure and amount of water to be handled are not mentioned. The enclosed sketch suggests a form of jet which may be modified to suit ESB's needs. The dimensions given are those actually used. Note that the plugs are tapped one-half of the length from one end, reversed, and tapped one-half from the other end. The length of the smaller nipple should not exceed one-half that of the larger, and the smaller flared end should be one-half the diameter, or less, of the larger. These flares can be made by heating and using any convenient flaring tool.

Arlington, Va. W H MCKINNEY

OPERATING SHORTS

Special Nipple Heats Press Uniformly

AN OPERATOR of one of the steam-heated presses in our laundry complained that one end of the press was hotter than the other. This seemed impossible as the press was heated with 100-lb steam, and the complaint was ignored. One day, however, we checked the press with a thermometer and were surprised to find it had a temperature of 280 F



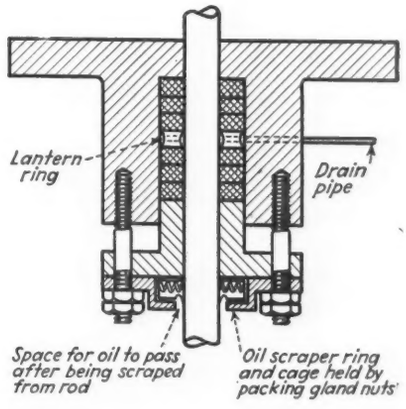
on the end where the steam entered the head and 330 F at the other end, see diagram.

We corrected this trouble by using a long-threaded nipple *A* extending well into the press. We plugged the inside end of the nipple and drilled a hole in its side. The hole in the nipple was faced toward the cold end of the press so that the entering steam would blow in that direction, to create a turbulence that would remove the air. This change caused the press to heat uniformly.

Cleveland, Ohio T C BROCK

Piston-Rod Scraper Prevents Oil Leakage

TWO VERTICAL CLOSED-CRANKCASE ENGINES required considerable makeup oil to maintain proper level in their cases. The diagram shows a cross section through one of the piston-rod packing boxes of these engines. The top three rings of packing prevents steam leakage from the cylinder and the lower three keep any cylinder condensate from entering the crankcase. A metal lantern ring between the two sets of packing rings permits draining away condensate from the cylinder and oil that comes up from the crankcase through the packing.


Lantern ring
Drain pipe
Space for oil to pass after being scraped from rod
Oil scraper ring and cage held by packing gland nuts

Oil leakage into the lantern ring was excessive and flowed out through the drain pipe with the condensate. Various types of soft and semi-metallic packing were tried to prevent the oil leakage, but without success. We then purchased a sectional metal scraper ring with garter spring and made a cage for it from steel plate. This cage was fastened under the gland nuts to hold the scraper around the shaft, which reduced the oil leakage to a small part of what it had been previous to installation of the scraper.

Buffalo, N. Y. R E FONTAINE

ARGUMENT CORNER

Scotsman's Goat Intact

IT WAS GLORIOUS to see the beautiful sentiments expressed about the Scotman's goat in this corner, June POWER. The strange part is that the goat did not get bounced, but rather a species of eagle worked up a malarial sweat because the goat grinned.

It is said in this country that an Englishman sees through a joke one week after it had been told. Well, I think the eagles must have been English, because they did not get the point of the comic vein in the letter and the fact that generalities were used.

I am sorry I was not on the banks of the River Clyde to watch Bell's comet, when that pea pod sailed up the river in the year of grace 1812. Also, it was my tough luck that I missed sailing across the Western Ocean on the Scotia of the Cunard Line, with it's "20-pund bilers". I thank Mr McKinney for the information as to the date of construction of that illustrious vessel. I did not bother checking up, but I'll take your word for it, that it was the year 1862, when she was launched at "Glesca toon".

Y'see, it's an awful business, the boiler business. I have been working around them for a long time, and it is strange that I never read any such tripe as differences between boiler pressures, as mentioned in the "Scotsman's goat;" *until* I arrived in these United States almost 17 years ago. That was when I saw tugboats exhausting into the atmosphere for the first time. The rocking-beamed-engined ship was a pleasure steamer, and that stuff in 1923. Tugboats have the same boiler pressures, no matter whether condensing or non-condensing. I've worked on them! This is 1940. Boiler pressures throughout the world are in and beyond the 1000-lb-per-sq-in. mark, and tugboats still exhaust into the atmosphere, and the conditions are the same no matter what the country.

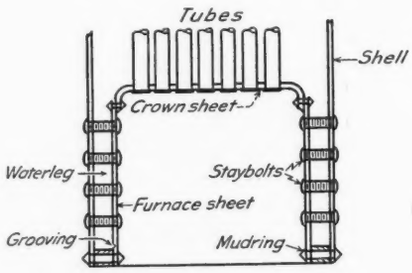
Another point to remember is that while one boiler has the fire practically against the shell and the girth seams, there is no comparison between this type and a Lancashire boiler or Cornish boiler. The idea of the hrt is practically similar to hoisting a Scotch marine boiler on a brick box. The peculiarity of the hrt boiler is the fact that it stays tight and the seams do not leak. Neither do the tubes, yet that poor shell gets more punishment than any other type of boiler on the market.

Just the same I would like to know the guy who invented the Scotch marine boiler, or the hrt. Also, I would like to know if Mr McKinney's first name is Wullie.

Now a wee word for Charlie Hubbard. Y'know, Charlie, I'm surprised at a man o' your intelligence, thinkin' that I was hot under the collar aboot reference to Scotchmen in Mr Rowley's article.

The whole thing turned out a good story, and brought—well y'see what was published in June POWER—just twa daft letters, written by poor Englishmen. Aye, us Americans must stick t'gether.

Grand Rapids, Mich. J M GORRIE

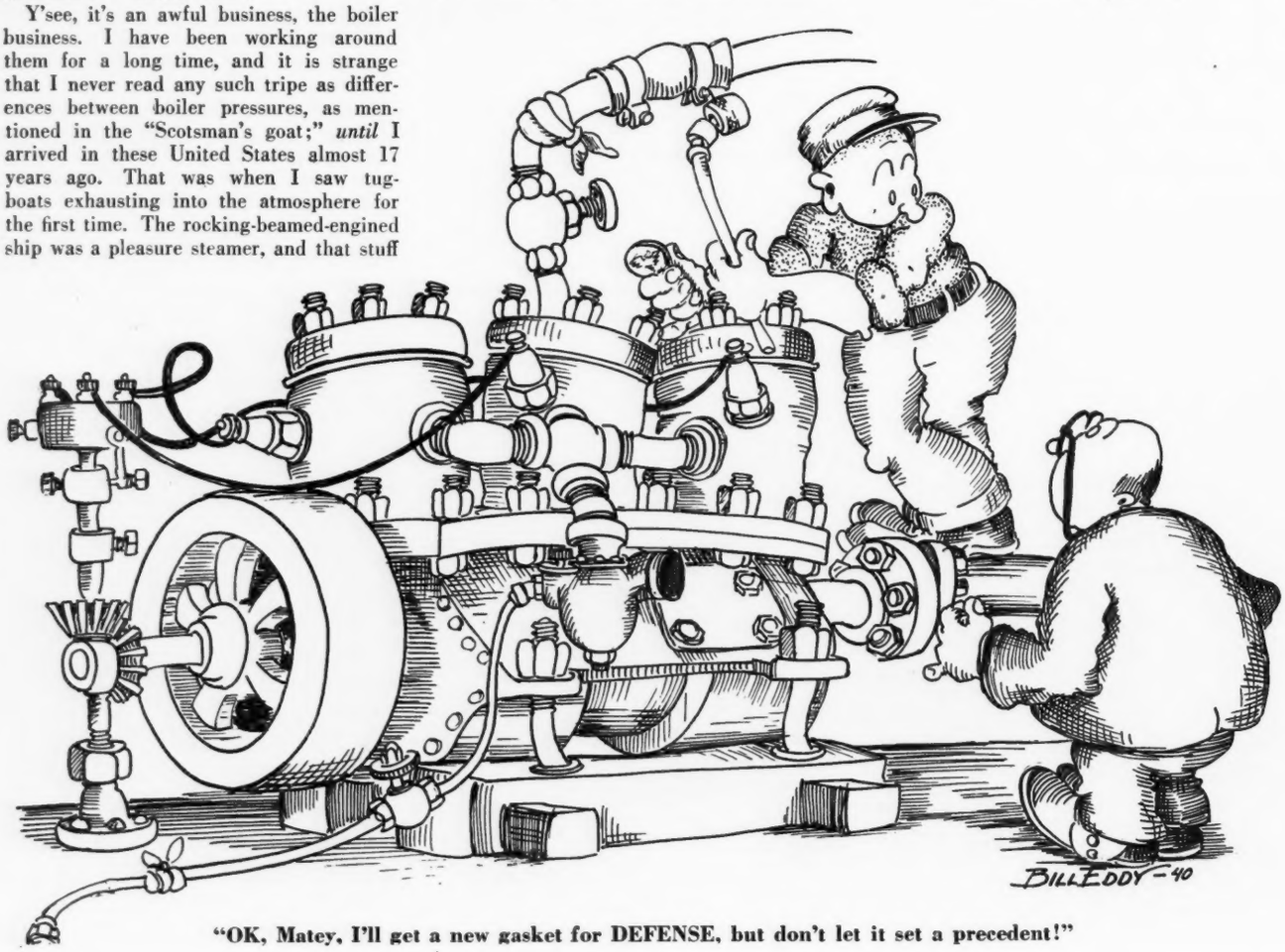


Forced Circulation

I THINK THAT THE TITLE "Forced Circulation Stops Corrosion" heading an article in June POWER is incorrect and may prove misleading.

The article described a condition known as grooving, that developed in the water leg of vertical tubular boilers. It was stated that this condition occurred after oil burners had been installed. Although the exact location of the grooving was not stated, it may be assumed that it was adjacent and parallel to the mud-ring, see sketch.

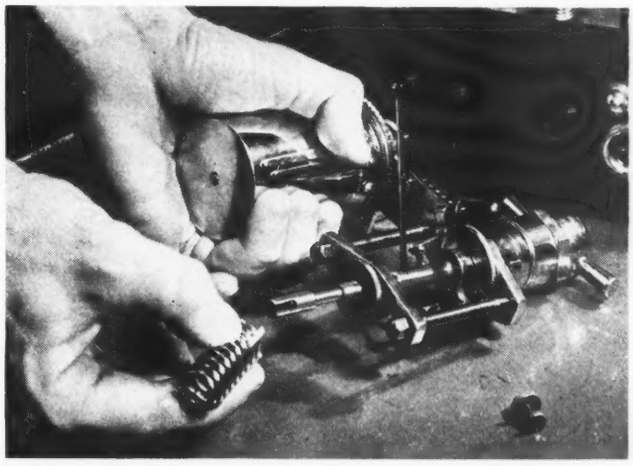
(Continued on page 146)



"OK, Matey, I'll get a new gasket for DEFENSE, but don't let it set a precedent!"

HOW TO INDICATE A STEAM ENGINE

THE FOLLOWING STEPS in setting up and using an indicator on a uniflow steam engine were posed by POWER through the courtesy of Warren Lewis, chief engineer of the Hotel New Yorker. Indicator pictured is of outside-spring type, suitable for superheated steam. The engine illustrated here has a built-in reducing motion and permanent indicator piping with 3-way cock, so that both high- and low-pressure ends of the cylinder may be indicated from one position.



1 →

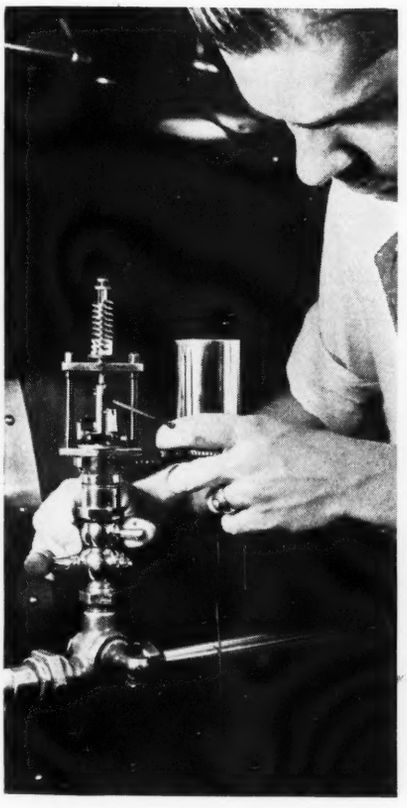
From the set furnished with the instrument, select a spring suited to the engine pressure. For a non-condensing engine, spring rating in pounds (per inch of pencil travel) should be about half the engine throttle pressure, so that up and down motion of pencil will be about 2 in. In this case, an "80-lb" spring is selected for 150-lb throttle pressure

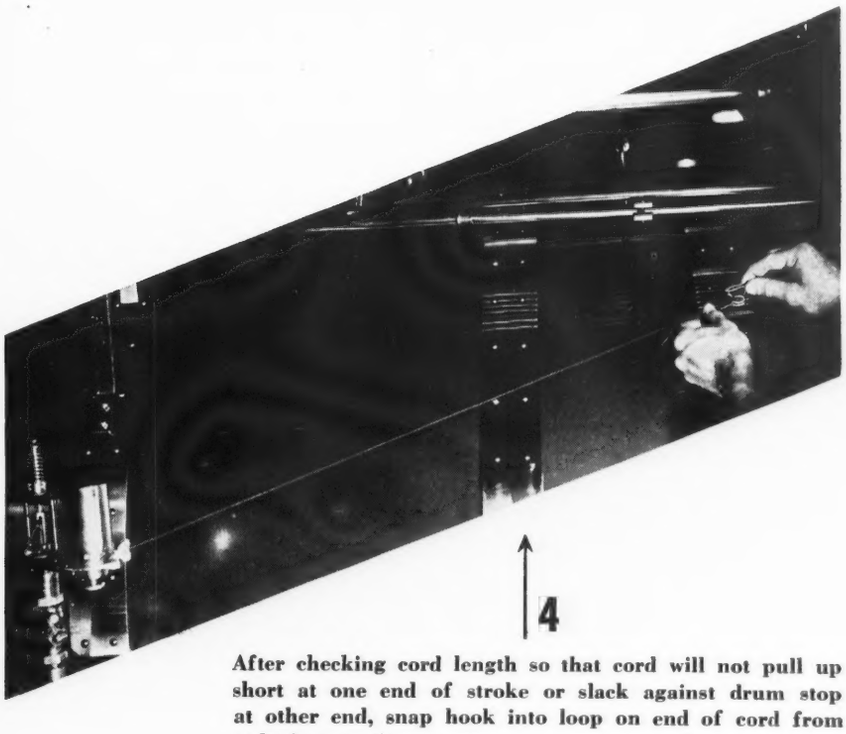
2 →

After screwing spring solid against lower nut, clamp ball top of spring with thumb screw and knurled lock nut

3 ↓

After portable indicator cock has been screwed into the permanent 3-way indicator cock of the engine, tighten the indicator union with the indicator positioned for convenient lead-off of the drum cord to the reducing motion



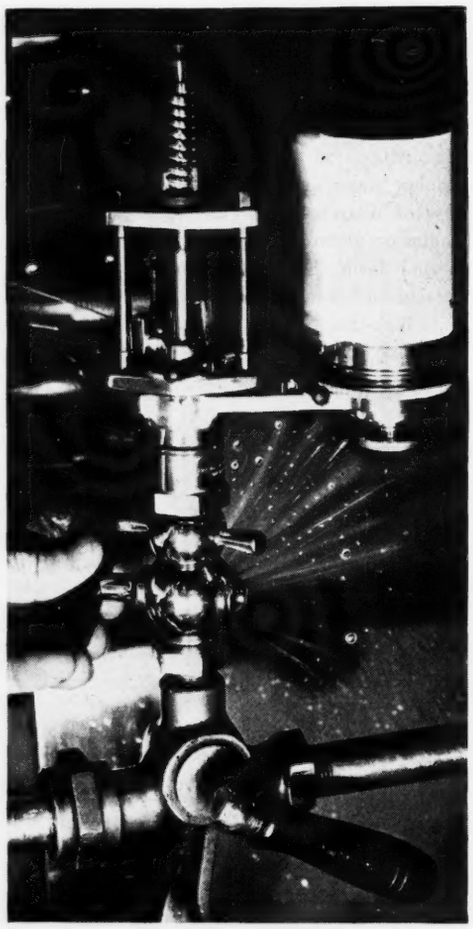


↑ **4**

After checking cord length so that cord will not pull up short at one end of stroke or slack against drum stop at other end, snap hook into loop on end of cord from reducing motion

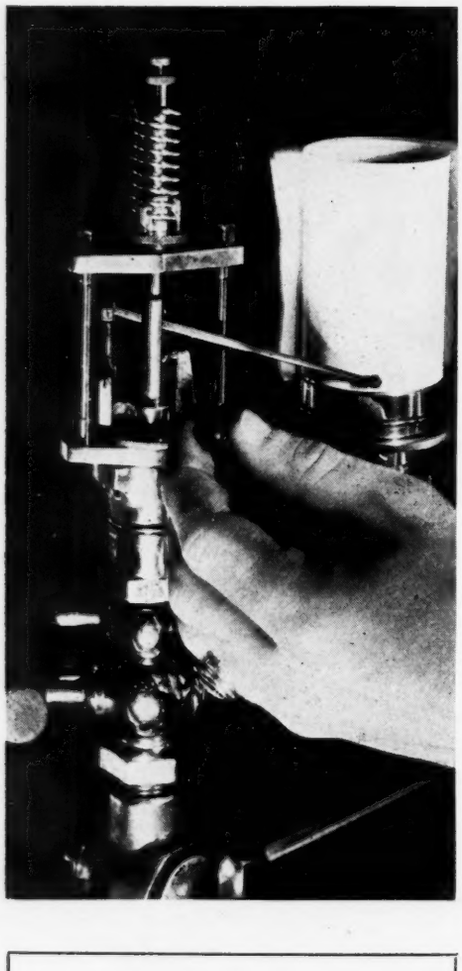
5

Throw reducing motion to dead position, then slide standard indicator paper down over drum with ends projecting between prongs. Pull ends through with left hand while smoothing with right, so paper fits tight against drum



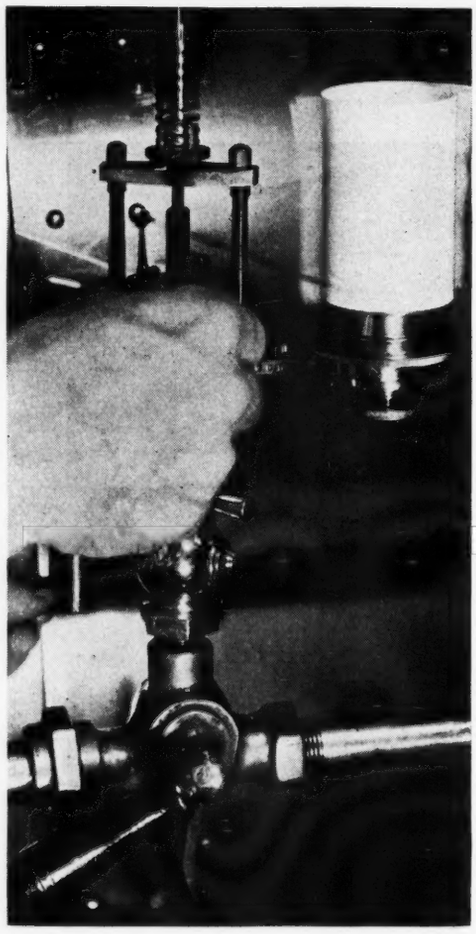
6

Turn engine (lower) cock to connect with crank or head end of cylinder as desired. Then turn indicator cock to the angle shown to allow condensed moisture to blow out through hole in side



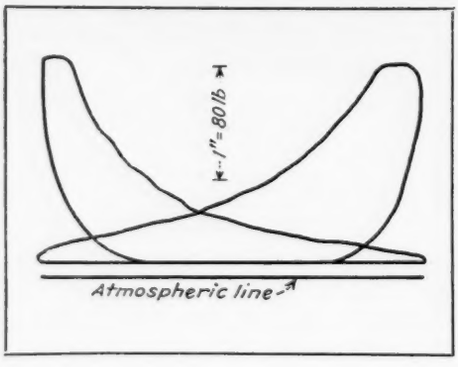
7

Turn indicator cock to "off" position. With drum in motion, use knob shown to press pencil lightly against the moving drum. Leave in contact for several double strokes to mark a clear "atmospheric" line



8

Turn indicator cock to "on" position. Then press pencil frame lightly against drum for a complete cycle. If engine is running at steady load, pencil may be left in contact for several revolutions, if desired. Back pencil off, switch engine cock to other end of cylinder and repeat



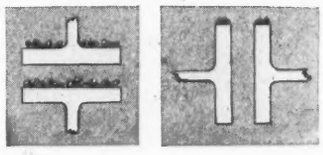
9

(Sketch) These are the actual diagrams taken in these tests, except that pencil lines have been inked for clearness

Note: Many operators prefer to draw the atmospheric line after the diagrams have been made to make sure that the spring is heated to its normal working temperature. This precaution is worth while with an inside-spring indicator.

ARE FACTORIES CLEANER THAN HOMES?

The amount of dust and grime that *settles* on the floor of your own home should answer once-and-for-all the kind of Motor Control you should buy for your factory. Do you think there is any *less* dust and dirt in and on your Motor Control than there is in your home? Of course not. And you know what that dust does if it piles up on your Motor Control contacts. So you, too, will insist on *vertical contact* Motor Control, Cutler-Hammer Motor Control in which the *vertical* contacts by their very design can't collect dirt, must *stay* clean, must work better, must last longer. Standardize on Cutler-Hammer and see the difference in performance and maintenance costs. CUTLER-HAMMER, Inc., *Pioneer Electrical Manufacturers,* 1358 St. Paul Avenue, Milwaukee, Wis.



The problem of dirty contacts . . . solved so simply it's almost funny. And yet Cutler-Hammer is the ONE Motor Control that uses vertical contacts exclusively.

Insist on CUTLER-HAMMER MOTOR CONTROL C-H *Dust Safe* VERTICAL *Contacts*

Modernized Belt Drives Cut Costs, Increase Production

L H Skougor, research engineer for the American Leather Belting Assn, proves his point with several typical installations

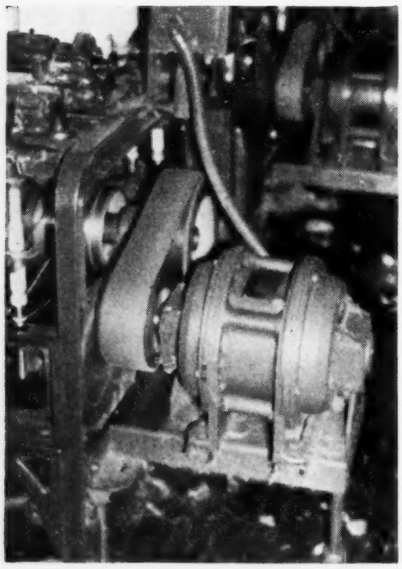


Fig. 1—Modern flat-belt drives can operate on centers so short that the pulleys almost touch

▶ RADICAL IMPROVEMENTS have been made in practically every type of power-service equipment, but for the most part industrial management has been satisfied to get along with the old designs as long as they do the job. This in spite of the fact that frequently modern apparatus pays for its first cost in a short time.

The Modern Way

Modern motors have higher efficiencies and power factors and better starting characteristics than older types. Belts, pulleys, shaft-bearings and hangers have been improved and better methods of applying them have been developed. Short-center belt applications impossible a few years ago are now highly satisfactory. Instead of long heavy line shafts in sleeve bearings difficult to keep in line and operating with high friction losses, modern group drives use shorter and lighter shafts in anti-friction bearings supported for easy alignment. These and many other improvements in power application make it economical to replace old installations with new equipment.

Regardless of machine arrangement to expedite production, power-transmission equipment plays a more important part in lowering production costs than is generally realized. Correct power-application equipment properly installed and maintained, not only cuts power and other operating costs, but, of far more importance, increases production output and may improve the product. A drive may appear to be running satisfactorily, but a close check may show a drop in machine speed that represents the difference between non-profitable and profitable operation. Some illustrations of improved operation that may be obtained with modern belt drives follow.

A large textile mill made a trial installation on a spinning frame, putting in a flat-belt drive on a pivoted base

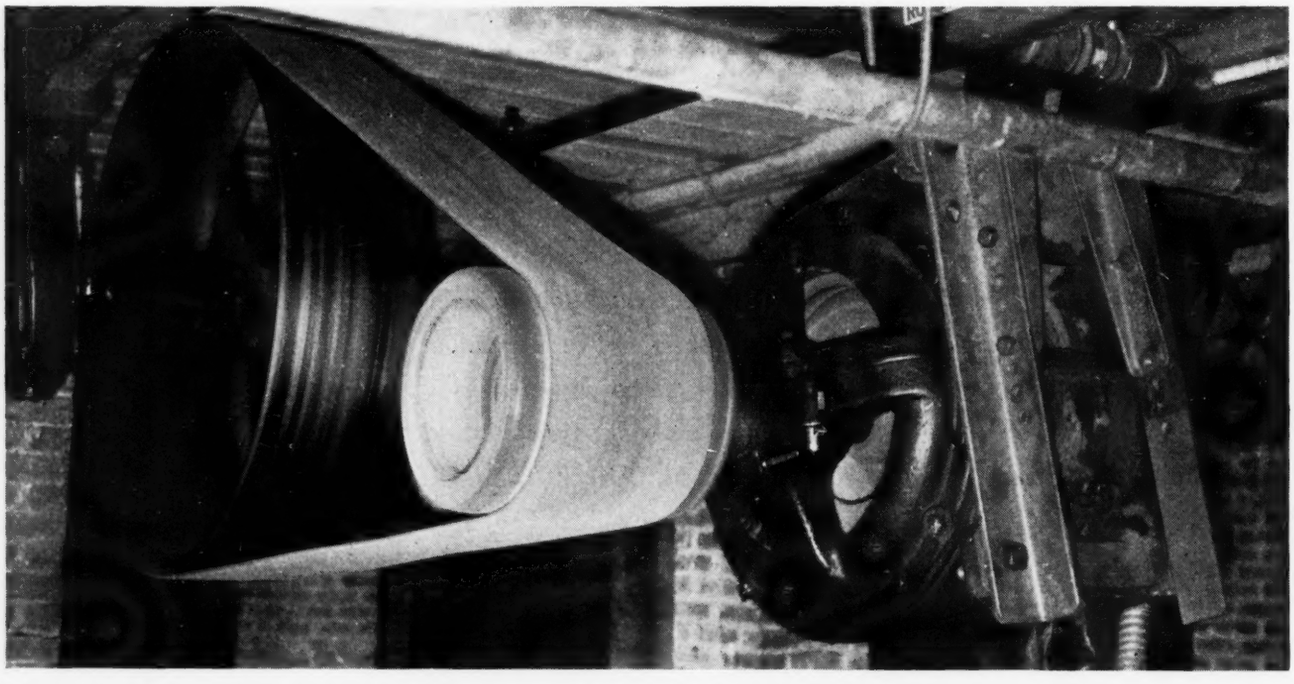


Fig. 2—Placing line shafting and motors on the basement ceiling eliminated overhead power equipment in this mill machine room

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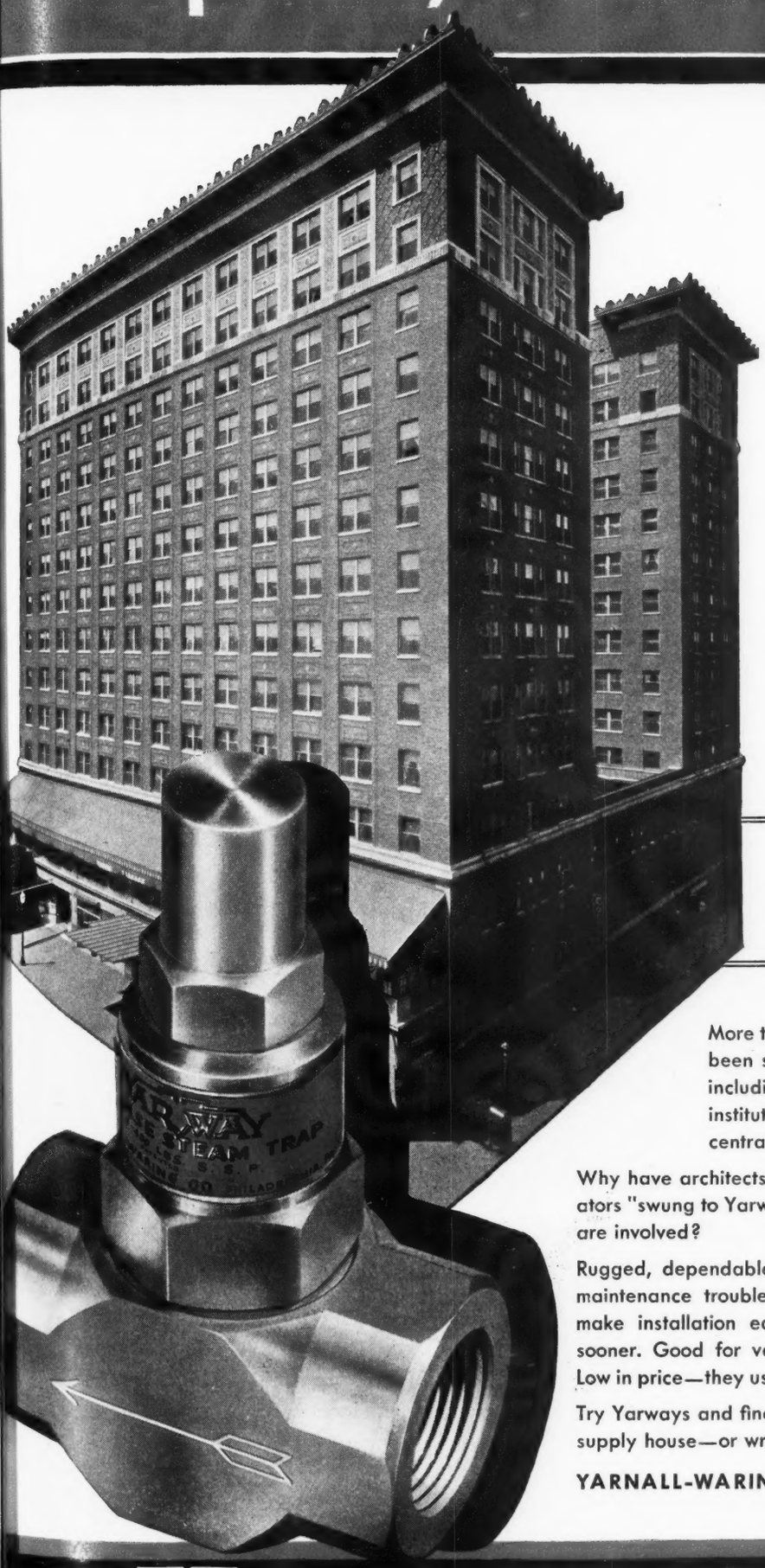

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YARNALL-WARING CO., 100 Mermaid Ave., Philadelphia

YARWAY IMPULSE STEAM TRAP

Modernized Belt Drives Cut Costs

(Continued from page 112)

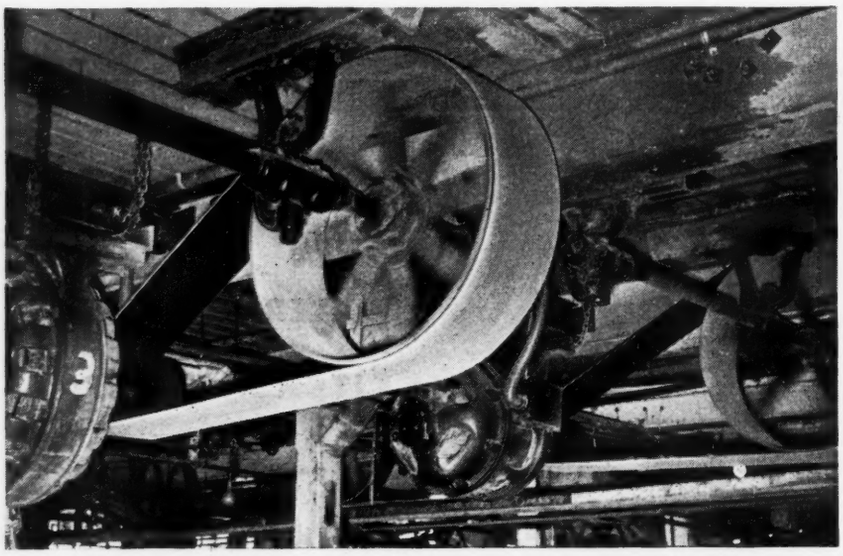


Fig. 3—Mounting these motors on automatic tension bases permitted reducing the center distances of the belt drives from 30 to 7 ft

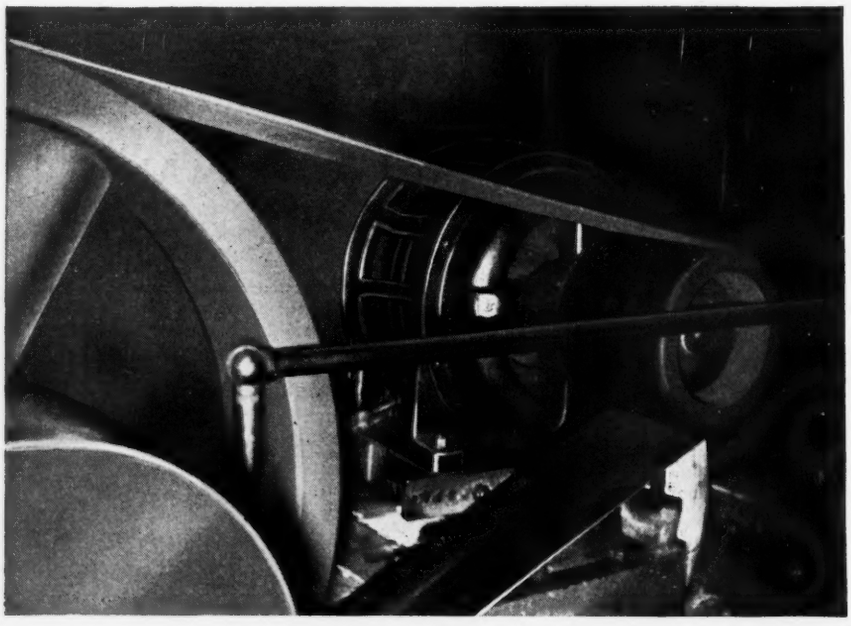


Fig. 4—On this air-compressor drive, belt trouble was corrected by mounting the motor on an automatic tension base

motor to maintain automatically constant tension in the belt, see Fig. 1. Machine drive-shaft speed was within 2 rpm of the desired operating value of 1120 rpm. A test made of several old drives showed a difference of as much as 60 rpm in machine shaft speeds driven by apparently identical motors, pulleys and belts. This was a surprise to the mill superintendent, who, after finding he could get the speed he wanted from additional new drives, completely re-equipped the mill. Increased production with the new equipment paid for the installation in a short time.

The advantage of having a clean-looking machine room without a forest of overhead belts, shafting and pulleys cannot be disputed. Several textile mills have changed old overhead group drives to modern designs installed under the floor in the basement below the machines. Belts from pulleys on the shafts drive up through the floor to each machine. Thus the advantage of modern group drive is obtained without any of the disadvantage of overhead equipment in the mill.

In one of these mills the motors on the old drives were connected to the line shafts by belts operating on 30-ft centers. Fig. 2 shows one of the new drives with only about 6 ft between shaft centers; the motor is mounted on a base to keep proper tension in the belt automatically. Power factor of these motors connected to modern group drive line shafts is 0.86 compared to 0.72 of small motors on individual drives in another part of the mill. Placing the motors and shafting of the modern group drives in the basement not only cleared the machine room of all overhead equipment, but also improved working conditions and reduced humidity-control load considerably.

Reduces Belt Length

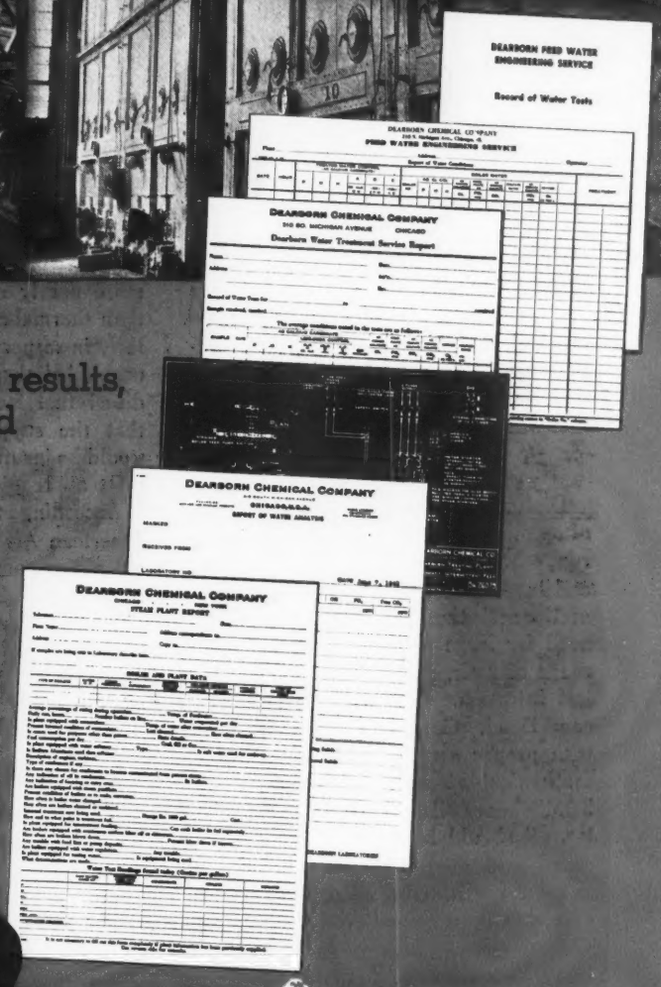
In another mill three 75-hp ceiling-mounted motors powered line shafts through belts operating on 35-ft shaft centers. These belts gave trouble and had a rather short life. Mounting the motors on bases to keep correct tension in the belts automatically and reducing the center distances to about 7 ft, Fig. 3, cured the trouble. Using the same kind of belt, made endless, on the new drives increased production nearly 5%. This saving in operating cost more than paid for the cost of the change in one month. As a result of this experience the mill superintendent modernized the power transmission equipment throughout the plant with a resultant 2.4% increase in production capacity.

Belt Life Increased

Fig. 4 shows a 100-hp motor driving an air compressor through a flat belt that originally operated on fixed centers. It was difficult to keep the belt from slipping and it had a short life. The belt was in such condition that a new one was ordered and at the same time the motor was installed on a base to keep correct belt tension. Result: over a year later the old belt is still in service and the new one is in storage.

These examples indicate a few of the ways that power transmission equipment may be modernized at low cost and how the saving from improved operation, increased production and lower maintenance and replacement costs pay for the new equipment in a short time.

NO TWO steam plants are exactly alike!



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Diesels in the Limelight

Fuels, accessories, engine design and performance, shaft couplings and applications share attention at ASME Oil and Gas Power Meeting, Asbury Park, N. J., June 19-22

▶ GIVING THE OPERATOR'S VIEWPOINT on purchasing of fuels for large diesel plants, J Bryan Sims, superintendent, Board of Public Works, Grand Haven, Mich., outlined the oil supply situation, with particular emphasis on the part played by the small refiner, and commented briefly on diesel combustion problems. Choice of fuel depends largely on local economic factors, but a majority of large engine users seem to buy a blend of distillate and residual oil, tending to use lighter fuels to reduce maintenance and make operation easier. Real savings can be made by burning residual fuels, either straight-run or cracked, and Mr Sims stressed the importance of large-engine users working with manufacturers to secure engines that will burn lower grades successfully.

Fuel Oils

Discussion revealed some difference of opinion as to the ability of diesels to run economically on cracked residues and bunker oils. Glenn Boyer, Burns & McDonnell Engrg Co emphasized the need for large engines to burn a wide range of fuels, preferably with mechanical injection. G W Baierlein, American Bosch Corp, pointed out that, with proper arrangements, present-day mechanical-injection equipment will handle heavy oils. For this kind of service, oil should be reheated and centrifuged, and adequate venting is needed to get rid of harmful gases. The engine should start on a good grade of light oil and operate on this same fuel for a few minutes before shutdown. Cooling spray nozzles will prevent coking and clogging and proper choice of materials will reduce corrosion difficulties.

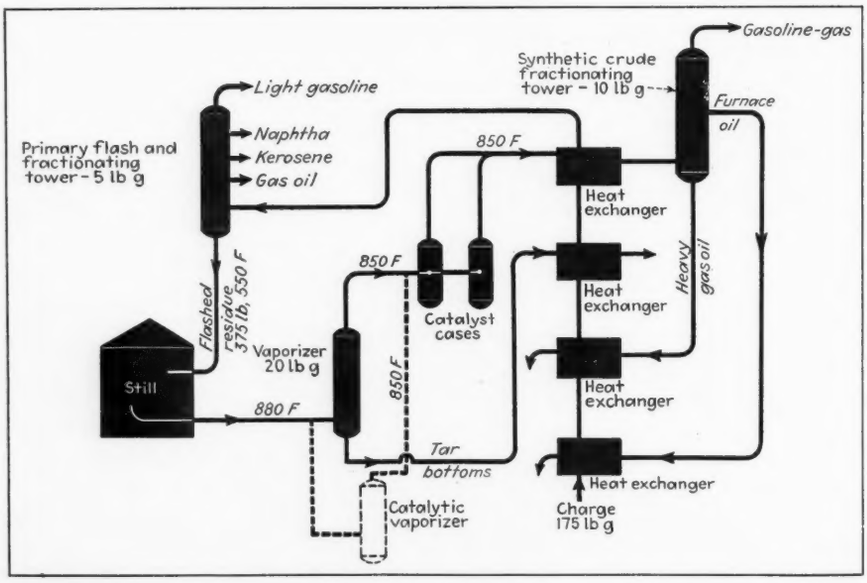
H C Major, Commissioner of Public Utilities, Rockville Center, N. Y., and G D Noiles, chief engineer, Hudson, Mass., both cited experiences with heavy grades of fuel and indicated that maintenance costs and operating difficulties made a return to somewhat lighter grades advisable. Mr Major stressed, however, the difficulty of evaluating the effect of fuel on maintenance and expressed skepticism of short-run data.

Describing the widely publicized Houdry process, W S Mount and E T Scafe, Socony-Vacuum Oil Co, pointed out that while this refining method is best known as a way to produce gasoline of high anti-knock quality, Houdry catalytic cracking produces usable distillate fuel and gives a total liquid recovery greater than for thermal cracking alone. The authors presented data on yields for various crudes, indicating that, in general, Houdry-cracked fuels more nearly resemble straight-run oils than thermal-cracked products, particularly in respect to ignition quality. They concluded that should the demand for diesel fuel increase to such an extent that the supply of straight-run fuels would be insufficient, Houdry oils should meet all requirements satisfactorily.

According to William K Gregory, American Air Filter Co, Inc, a practical air cleaner for diesel service must have: (1) a high air cleaning efficiency, (2) a sufficiently low resistance to air flow so as not to appreciably reduce power delivery, and (3) a design that can be kept in serviceable condition with a minimum amount of attention and expense. Dry filters give high efficiency and low resistance at the start but lose effectiveness quickly and are apt to be troublesome and expensive to maintain. Washable viscous-impingement filters also give satisfactory efficiency and low resistance when clean but must be serviced regularly, an inexpensive but messy job. The automatic oil-coated filter cleans itself automatically, holding satisfactory efficiency and reasonably low resistance indefinitely. However, units of this type can rarely be justified for engines using less than 5000 cfm or more, due to cost of electrical mechanism, oil tank, etc.

Oil-bath filters more nearly meet the requirements of an ideal filter except for higher resistance. Mr. Gregory described several types of oil-bath filters and discussed in some detail the development of a filter of this type with a resistance considerably lower than previous units. High cleaning efficiency, high dust holding capacity and ease of servicing make these units particularly suitable for use where dust storms are prevalent. Mr Gregory stressed, in conclusion, the importance of establishing a test code for diesel air filters.

Reporting on the effect of variations in atmospheric conditions on diesel-engine performance, Jesse S Doolittle, the Pennsylvania State College, stated that changes in air density as high as 15% fail to materially affect the fuel rate if the engine operates below the load of minimum fuel rate, but that if the engine is operated at loads above



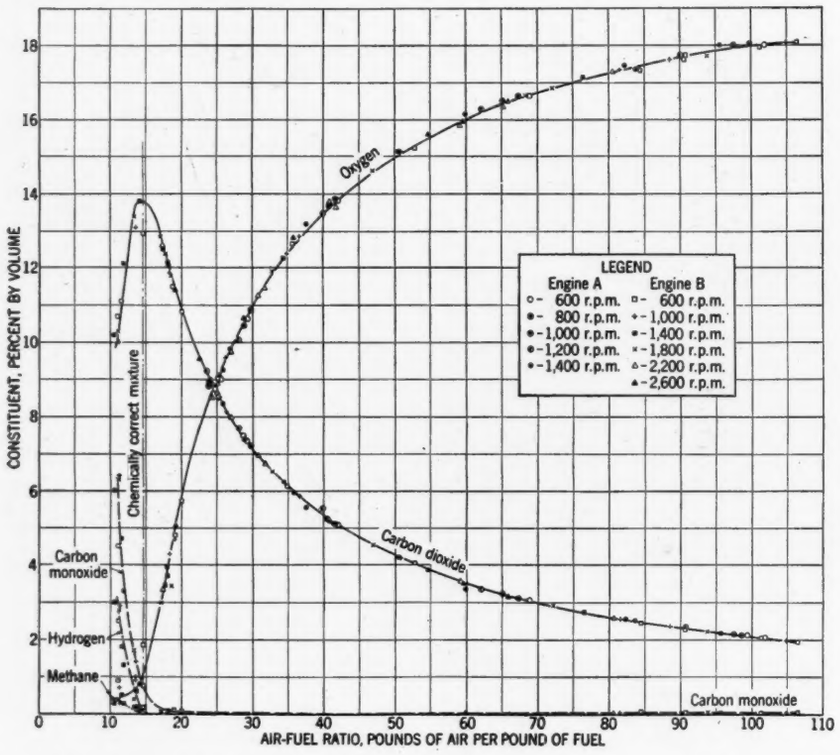
The Houdry process of catalytic cracking, now widely used, produces high yields of distillate fuels suitable for diesel use and of better ignition quality than thermally cracked fuels; here's how the process works

MANY users of the Nalco System say that they have almost forgotten the old days when feedwater treatment was a problem. If you are still worrying over this problem in your plant, we urge you to see a Nalco field engineer at once. Write NATIONAL ALUMINATE CORPORATION, 6222 W. 66th Place, Chicago, Illinois.

The Nalco System of Feedwater Treatment

Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay St., Toronto, Ont.

(Continued from page 116)



Diesel exhaust contains less than 0.12% carbon monoxide while excess air is present; at low air-fuel ratios concentration of CO increases and hydrogen and methane appear in significant quantities.

pressure, temperature or humidity will influence the amount of air taken into the cylinder and, due to the insufficiency of air present under these conditions, will influence both fuel rate and maximum power output. A further conclusion resulting from the tests described applies particularly to 2-cycle engines: if, due to the engine design, setup, or operation, the pressure differential between the scavenging air and main-cylinder pressure is abnormally small, then changes in either the exhaust or intake pressures will measurably affect air flow to the engine and will change both fuel rate and maximum power output.

Modern materials and aerodynamic research make the combustion gas turbine a practical reality after years of experiment, dating back to the latter part of the 18th century. J T Rettaliata, Allis-Chalmers Mfg Co, described the construction of units in successful use today and analyzed the cycle of operation. With the aid of numerous charts, he discussed the characteristics of the turbine and the axial compressor which is such an important part of the combination, showing the effect of various factors such as efficiency, pressure ratio, turbine inlet temperature and also the effect of introducing heat exchangers and other devices for improving the over-all efficiency of the cycle.

In a session on shaft couplings, N L Alison, R G Olson, and R Nelden, American Blower Corp, and A D Andriola, Electric Boat Co, presented the characteristics of hydraulic and electric couplings respectively. Both types now find wide use for coupling diesels to driven members, particularly in the marine field. Use in connecting engines to propeller shafts brings a high degree of maneuverability to motorships and by eliminating a rigid coupling between engine and shaft avoids vibration difficulties considered inherent in ships with diesel power.

In an informal progress report on a special research project, P H Schweitzer, the Pennsylvania State College, told of increasing the oxygen content in air supplied to diesel engines. Best results were obtained when total oxygen content of the air supplied ran about 45–55%; power output increased about 60% due to a gain in the amount of fuel burned without smoky exhaust and to a decrease in ignition lag. BMEP ran up to 135 lb from about 85, and exhaust temperature increased to about 1100–1200 F. A possible application of importance would be to boost the power of a diesel aircraft engine to supply the extra ⅓ output needed for takeoff.

An investigation by the Bureau of Mines of the hazards that might attend use of diesels underground, involving precise determination of the composition of exhaust from two 4-cycle, 4-cylinder engines revealed that combustion is essentially complete when excess air is present. John C Holtz and M A Elliott described testing with a wide range of fuel-air ratios and stated that when the engines were operated in their normal range of fuel-air ratios, the concentration of carbon monoxide never exceeded O. 12% and hydrogen and methane were never present in significant concentrations. Carbon monoxide concentration was affected not only by fuel-air ratio but by engine design and to a slight extent by factors that varied with engine speed. The paper also included a discussion of the diesel combustion process.

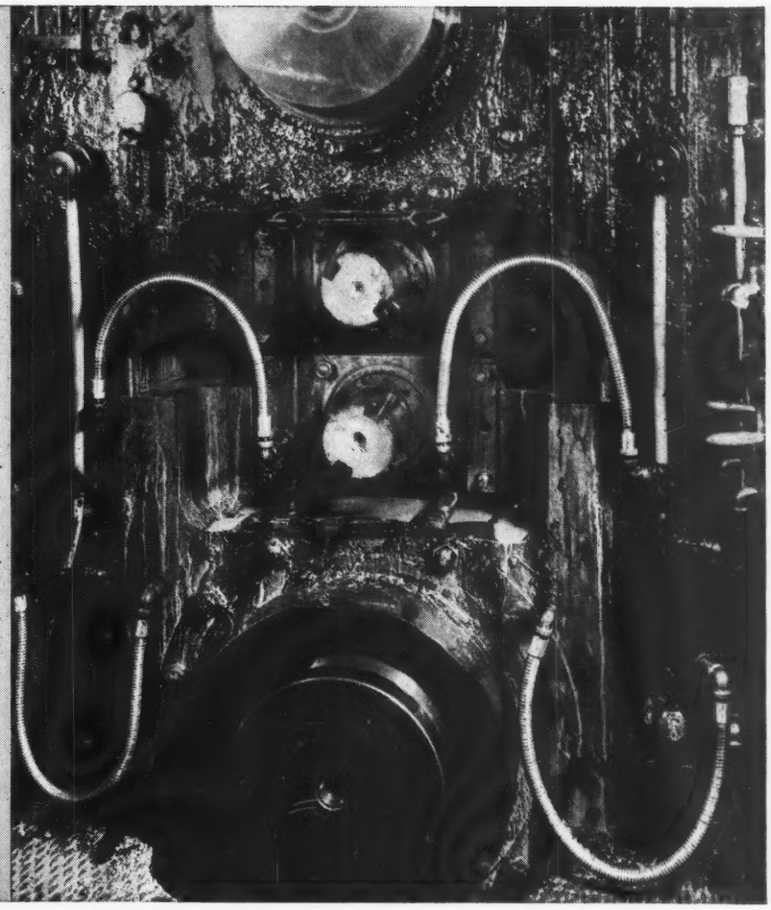
The trend to lighter and faster engines puts more importance on careful stress analysis and mechanical design; three papers, presented in a session devoted to design problems, attempted to cast light on this complex subject. In the first, R L Boyer and T O Kuivinen, The Cooper-Bessemer Corp, discussed stresses and deflections in reciprocating parts, from the point of view of builders of heavy-duty engines, and gave suggested rules of design for pistons, piston pins, connecting rods and piston rods, bolts, and connecting-rod caps.

Balance Important

Paul S Shirley, Diesel Engine Division, General Machinery Corp, emphasized the importance of balance and analyzed the revolving, reciprocating, and twisting couples and forces that are always present in one form or another in any type of reciprocating engine. Russell Pyles, Clark Bros Co Inc, described the method of obtaining the forces tending to produce horizontal vibration in engine frames from the bearing-load diagrams and presented a simplified procedure for comparing stiffness of complicated frame structures.

In a session devoted to marine diesel applications, R W Bayerlein, Nordberg Mfg Co, described the design and construction features of 2-cycle engines built for Maritime Commission C-2 ships and Louis R Ford, Editor, *Motorship*, traced the history and development of marine diesel engineering.

4-high strip mill gets a lift from AMERICAN SEAMLESS!



Jack lines of tough flexible metal tubing transmit hydraulic power at 3,000-lb. pressure

EVERY time the huge rolls in this 4-high mill need adjustment—and that's every few minutes of the day—they rely on a flow of oil that builds up to a hydraulic pressure of 3,000 lbs. per sq. in. With orders heavy and delivery demands insistent, jack lines must be dependable—must be able to take this terrific beating without failing. That's why the connections you see here are American Seamless Flexible Metal Tubing, shielded with bronze braid and a casing of flexible metal hose.

This is but one of a thousand different applications of American Seamless that are showing plants new ways to economy where the conveyance of liquids and gases is involved. In Bulletin SS-25 (24 pages; 75 pictures) you will find many such applications explained in detail and illustrated with actual examples. Be sure to write for your copy today.

American Metal Hose

ANACONDA
from mine to consumer

AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Conn. • Subsidiary of Anaconda Copper Mining Company
In Canada: Anaconda American Brass Ltd., New Toronto, Ontario

WHAT'S NEW IN PLANT EQUIPMENT

Coal Unloader

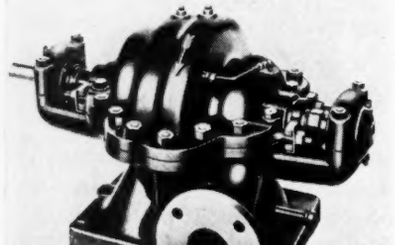
AS ACCELERATOR in unloading coal with high moisture content and tendencies to stick, device is said to unload car of coal in half usual time. Consists of crane-

mounted screws over railroad tracks where cars are unloaded. Operator in cab controls direction of travel of supporting crane and screws of accelerator in coal.

Stephens-Adamson Mfg Co, Aurora, Ill.

Two-Stage Pumps

SPLIT-CASE, 2-stage pumps have capacities up to 550 gpm. One-piece impellers are of cast iron, bronze, or other alloy, depending on requirements. They are mounted "back to back" on shaft, said to insure

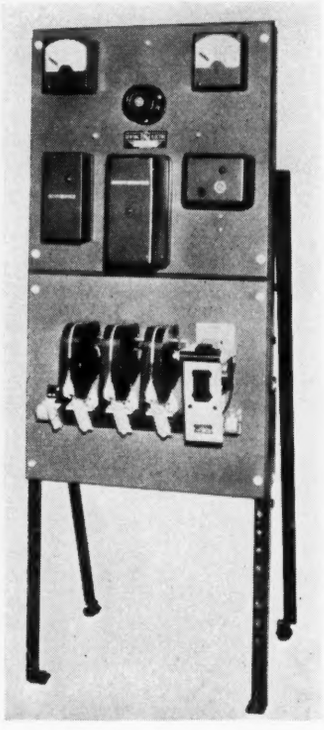


proper hydraulic balance. Removable wearing rings with streamlined water guiding surfaces are provided on both casing and impeller. Casing is horizontally divided so that upper casing may be lifted to expose entire rotating element.

Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago, Ill.

Synchronous Motor Control

CONTROL waits until motor reaches correct speed and then selects an instant of favorable angular relation of stator and



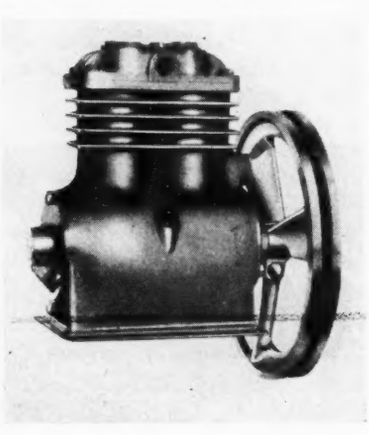
rotor poles to apply field. SCI relay prevents pulsations in case of motor pull-out by disconnecting power (or field, if automatic resynchronization is desired). Protection of squirrel-cage winding is provided by separate relays which match different characteristics of two windings.

General Electric Co, Schenectady, N. Y.

Compressor

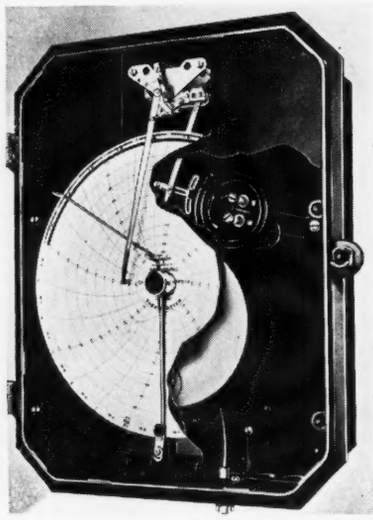
MODEL X-8 is a single-stage, duplex-cylinder compressor having piston displacement of 8.7 cfm at maximum speed. Cylinder and crankcase have been cast in one piece, and crankshafts are drop-forged, heat-treated steel. Lubrication is constant level-splash type, while cooling is accomplished by deep horizontal fins on cylinder. Valves are mounted in head and each can be removed for inspection without disturbing others.

Quincy Compressor Co, Quincy, Ill.



Recorders

COMPANION to line of Fulscope instruments, recorders can be used for temperature, pressure, humidity, load, rate of flow, liquid level, etc. Exclusive of con-

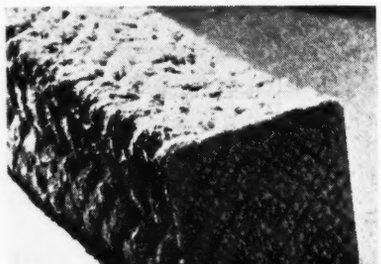


troller mechanism, recorders and recording controllers are identical. New universal case is for both face and flush mounting, and dust and moisture are sealed from case by Neoprene door gaskets and bayonet-action latch.

Taylor Instrument Cos, Rochester, N. Y.

Braided Packing

LATTICE-BRAID packing has every braiding strand passing diagonally through the packing at angle of about 45 deg. This, according to manufacturers, makes for



completely unified structure. Advantages claimed for new packing include longer service, greater flexibility, controlled porosity and automatic action.

Garlock Packing Co, Palmyra, N. Y.

Pilot Relay

PHOTOSWITCH electronic relay is switch making possible control of large currents by delicate mechanism, liquids or extremely light contact pressure. Control is effected by delicate touching of two fine wires

RESCUED WITH A BY-PASS

A CASE STORY

SOLVED WITH PREVENTIVE MAINTENANCE

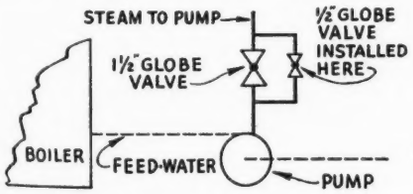
"Man alive"—shouted the SUPERINTENDENT—"we just replaced that valve a short time ago!"

"But we can't let the pump run wild"—the PLANT ENGINEER tried to explain.

"Sure enough"—said the CRANE MAN—"but Preventive Maintenance will stop the source of trouble."

AN eastern plant was having endless trouble with a valve on the boiler feed pump. It was a steam-driven pump—controlled with a 1½-inch globe valve.

Under peak loads or in an emergency, this valve was ideal for the pump. But for normal feed-water needs in this plant, it was much too large. Most of the time the steam was throttled so close that the disc and seat were barely



"cracked." As a result they soon became wire-drawn and the valve began to leak—a dangerous and wasteful condition.

Pulling the fire in a 24-hour day plant to make valve repairs was costly. A permanent remedy for the trouble had to be found. "Here is a case for Preventive Maintenance," said the Superintendent as he called in D. N. G., the Crane Man, on the problem.

With a knowledge of the service needs of the plant, an effective solution came quickly. To this end Preventive Maintenance counseled the installation of a ½-inch globe valve in a by-pass line around the present valve. With the large valve closed tight, the ½-inch valve, when fully open, would assure ample steam for normal pump operation. For emergency loads, the 1½-inch valve would be available—but rescued from severe throttling service.

Results: (1) The trouble and constant threat of a boiler shutdown were eliminated—permanently, easily, inexpensively. (2) Another plant management has learned that Preventive Maintenance pays for itself many times over in savings. (3) Another management knows that it can rely on Crane for sound advice on every piping problem and for the right valves and fittings in every need. Knows, too, that it's best to call the Crane Representative whether the trouble is big or little.

This case is based on an actual experience of a Crane Representative in our Syracuse Branch.

FINE FLOW CONTROL WITH CRANE BRASS PLUG DISC VALVES

In any service—steam, water, oil, gas—where valves must operate in partly open position or are frequently opened and closed, in every way these valves will give better performance than you would expect.

Crane plug-type disc construction assures accurate and easy regulation of flow, and a longer life of positive tightness. The wide seating surface and the perfect combination of alloys in the tapered disc and seat give unusual resistance to the damage of foreign matter and wire-drawing, to wear and galling. A sturdy brass body and careful engineering in every part make these valves extra fit for tough jobs.

Crane Brass Plug Disc Valves are the popular choice for Preventive Maintenance on soot blower, blow-off, boiler feed, drip and drain lines. They're made for pressures up to 350 pounds at 550°. For 150 pound lines, specify No. 14½P.

85TH YEAR

CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVE., CHICAGO
VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

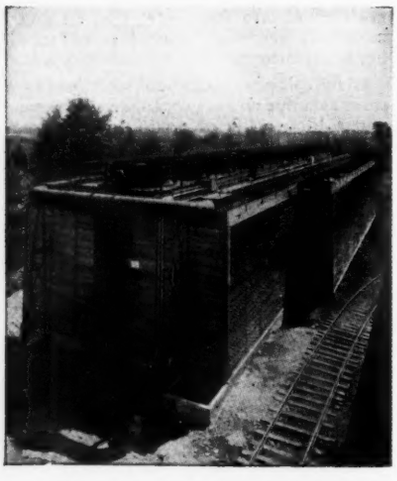
NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS

or contacts, or by their being short-circuited by a liquid or moist material. Unit is applicable to liquid level control, electrical recording equipment, electrical flowmeters, etc.

Photoswitch, Inc, 21 Chestnut St, Philadelphia, Pa.

Cooling Tower

FEATURES of "Double Flow" cooling tower include the fact that hot saturated air is not recirculated, unit has low pumping head, is lower in size than conventional-type tower, has special cast-iron hardware,



negligible drift moisture loss, patented eliminators, less makeup and chemicals, high cooling efficiency, external water distribution system, removable bronze nozzles, and Marley propeller-type fans.

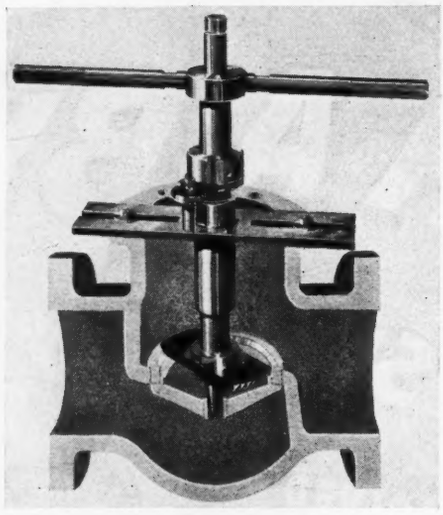
Marley Co, Fairfax Rd & Marley Ave, Kansas City, Kansas.

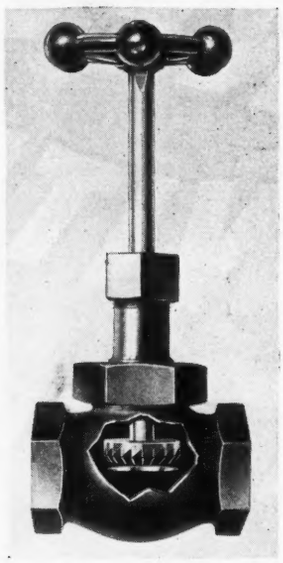
Controller Accelerator

NEW PRINCIPLE is used in this feedwater controller. Small stream of water is fed into control tube at its hot end, increasing valve motion through changing temperature of entire tube by positive volume control. In addition to maintaining precise control of boiler feedwater, this controller, with accelerator attachment, permits blowing control tube without throwing apparatus out of adjustment. Small filter is incorporated in line between tap-in on feed and accelerator valve, and back wash is provided, through which filter can be washed and freed of scale. Controller can be equipped with either whistle or electric alarm, so that if boiler pump fails, or pump packing becomes lodged under valve, warning will sound.

J A Campbell Co, 645 East Wardlow Rd, Long Beach, Calif.

Valve-Seat Refacers





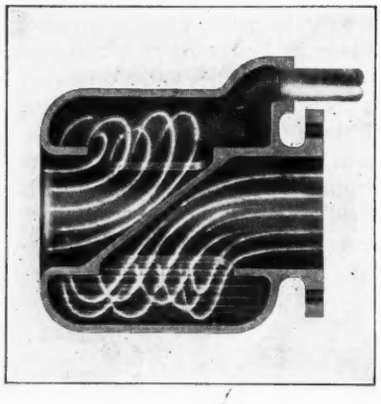
CARLAN AAB refacers renew seats on all makes of flat-seat globe, cross and angle valves. Two types of refacers available. Type "F" for flat work and Type "B" for bevel work. Type "BF" is flat tool for use on bevel valves. Tools available, either singly or in sets, in sizes from ⅜ to 8-in. All are self-centering, and reface valve without chattering. Illustration on right shows 1-in. bevel refacer assembled in valve ready for use. Other picture illustrates valve refacer mandrel, with centering device through spider. Latter type made in two sizes, 3 to 8 in., and 6 to 12 in.

Carlan Tool Co, 720 Edgar Rd, Elizabeth, N. J.

Exhaust Head

COCHRANE head said to insure separation of condensate and oil from steam discharged to atmosphere, at same time discharging steam noiselessly. Head incorporates principles of baffle-type steam separators used for removing oil and moisture from steam lines. Steam is whipped sideways after passing through port and causes projection of entrainment against ribbed baffle surfaces. High ribbed baffles exert a scrubbing action in addition to centrifugal pumping force.

Cochrane Corp, 17th & Allegheny Ave, Philadelphia, Pa.



Gage Strips

EXTENDABLE gage strips can be added, foot by foot, to fit any height, for gasoline, oil, and water tanks. Strips are one foot each in length, locked together by foot numeral inserts. Each strip is 2 x 12 in., and ⅛ in. thick, available in one of two finishes, molybdenum or chromium.

J A Campbell Co, 645 East Wardlow Rd, Long Beach, Calif.

Frequency-Load Control

EQUIPMENT INCLUDES frequency regulator, load-division regulator, time-error compensator, master clock and accessories. Frequency regulator is extremely sensitive device, says the maker, of simple and rugged construction. Induction-type relay is sensitive watthour meter element arranged to be responsive only to current from a resonant filter. Contacts for operating reversing contactor are sealed. Master clock is built to specifications, and is motorwound, weight-driven type. Photo-

(Continued on Page 134)

TRUE STORIES about Lo-Maintenance Motors that—

COULDN'T BE DROWNED . . .

Three times submerged by floods . . . actually running for hours under water . . . yet no trouble in 13 years! That's how two Allis-Chalmers Lo-Maintenance Motors have performed for the Beloit Box Board Co. And after each flood, all that was ever done was to wash the silt and dirt out of the motors and let them dry. In picture, R. M. Fisher, vice-president, Beloit Box Board Co., points to high water mark of recent flood.

COULDN'T BE STOPPED BY DUST . . .

In this chemical plant, fine chemical dust that bit like acid caused maintenance expense of over $500 on 22 motors of other makes. But 17 Lo-Maintenance Motors brought a total repair bill of only $17.30! That's why . . . when they needed 18 more new motors . . . they ordered from Allis-Chalmers!

COULDN'T BE KNOCKED OUT . . .

They were "killing" motors at the Alberene Stone Corp., Virginia, on their hard-pounding channeling machines . . . actually knocking them out! Then, four years ago, they tried Lo-Maintenances for the job. Now, every one of their channeling machines is powered with a Lo-Maintenance Motor . . . and there are no break downs . . . no time-outs for repairs!

That's What Happens When Allis-Chalmers Lo-Maintenance Motors Are Called On To Do Extra Tough Jobs! Find Out How to Get Motor Performance Like This in Your Plant!

There's a reason why Allis-Chalmers Lo-Maintenance Motors give performance that is more than just a rated horsepower. It's because, in Lo-Maintenance Motors, you get unusual full-measure features of construction and design. You get — twistless, distortionless stator . . . removable, indestructible rotor . . . sturdy high carbon steel frame . . . no skimping anywhere on materials or workmanship!

Just as Lo-Maintenance Motors do these jobs for others, they'll do them for you, too. Find out the facts . . . from the engineer in the nearest district office...or write Allis-Chalmers, Milwaukee . . . today!

A 1270

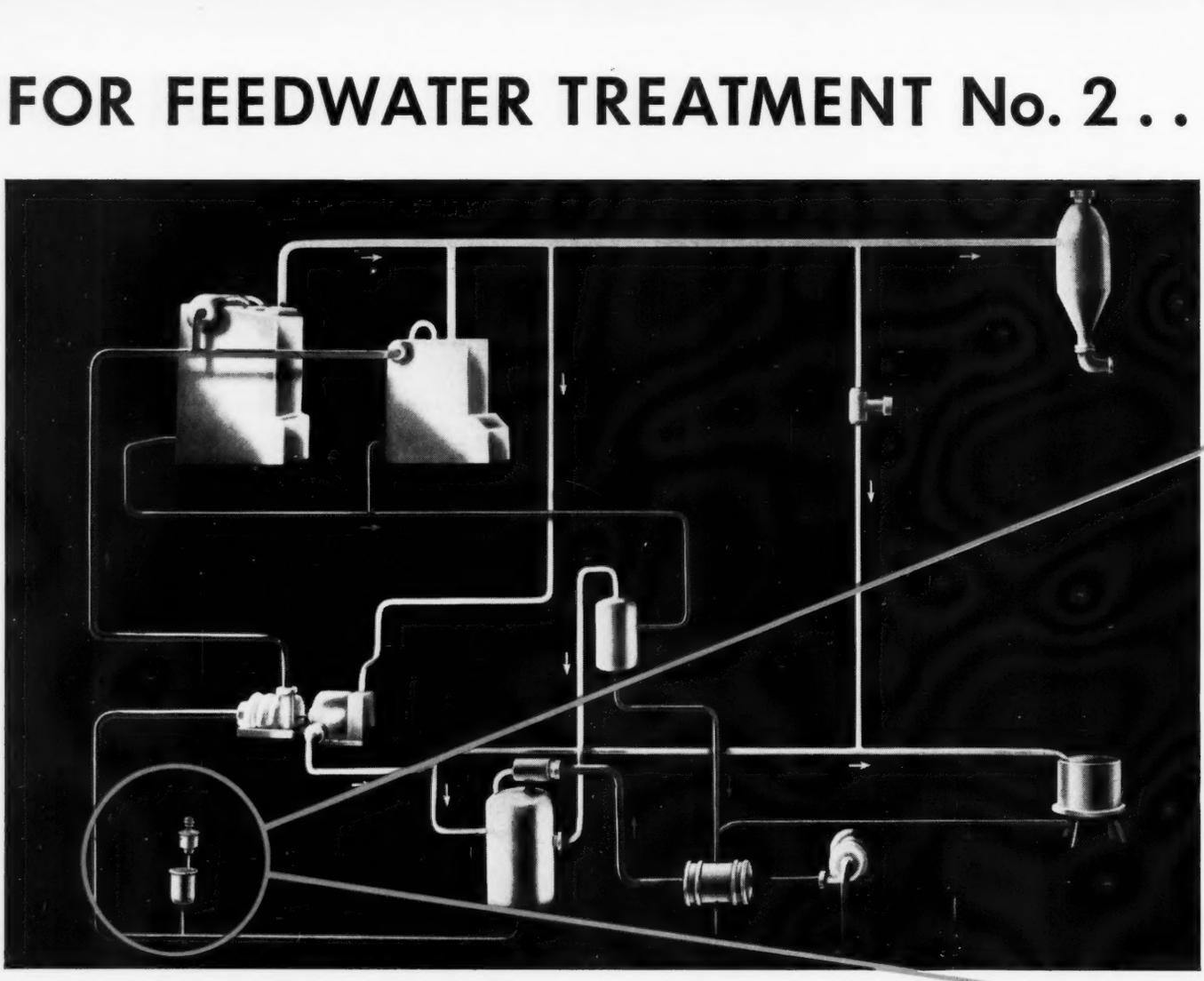
Over 90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

FROM *GOOD* POWER HOOKUPS

FOR FEEDWATER TREATMENT No. 2 . .



Courtesy—Power Magazine

HOOKUP #21 **In this chemical plant, steam is generated for process, power purchased. New h-p steam-generating unit meets increased steam load, operating temporarily at existing plant pressure, but providing for future h-p power generation without boiler change. Little condensate returns from process; heat from blowdown and contaminated process returns is recovered before water is wasted. To maintain condition of water in boilers, chemicals are added at suction side of boiler feed pump.**

FOLLOWING the Hot Process of water treatment shown last month, we diagram essential points of control for another method of adding chemicals to maintain specific conditions in the boiler drum.

Simplest method of introduction is at the suction side of the boiler feed pump. Solution, prepared in a mixer passes into the supply tank which can be put under slight pressure or elevated so that solution flows into the feed line by gravity.

An alternate method employs a motor-driven pump in which gear ratio and piston stroke can be regulated to meet the demand.

Here again, Iron Body Bronze Mounted Valves will safely handle some of the chemicals used on Solution Lines—although All-Iron or Stainless Steel Valves are available where necessary.

NEXT MONTH—BASE EXCHANGE

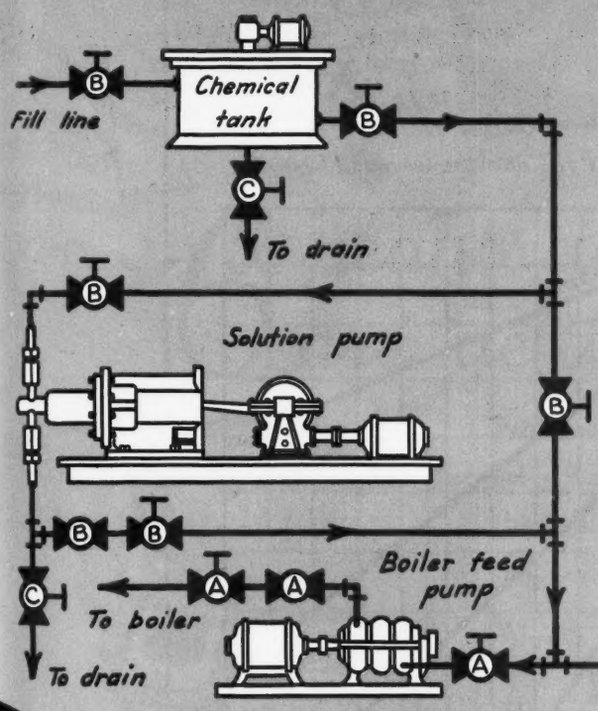
IN VALVES *Jenkins* GIVES YOU EVERYTHIN

. . . TO *GOOD* VALVE PRACTICE

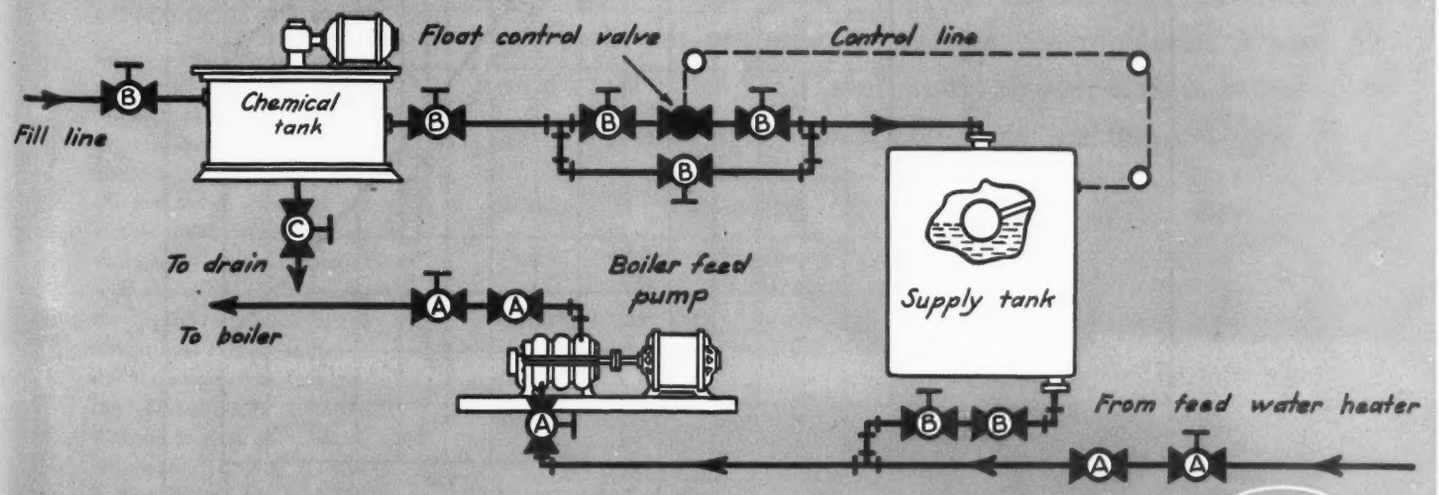
Jenkins RECOMMENDS . . .

CHEMICALS ADDED AT BOILER FEED SUCTION

Chemical Introduced With Pump



Chemical Introduced By Gravity



REFERENCE CHART TO JENKINS FIGURE NUMBERS FOR FEED WATER TREATMENT No. 2

		Standard	Medium	Extra Heavy
A	FEED WATER GATE	BRONZE 47 Sc. Travel. Spind. 49 Sc. Travel. Spind. 370 Sc. Non-Rising 70 Sc. Non-Rising 71 Fl. Non-Rising 72 Sc. O.S. & Y. 73 Fl. O.S. & Y. 368 Sc. O.S. & Y. IRON 325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S. & Y. 651 Fl. O.S. & Y.	BRONZE 270 Sc. Non-Rising 275 Sc. O.S. & Y. IRON 251 Sc. Non-Rising 255 Fl. Non-Rising 277 Sc. O.S. & Y. 253 Sc. O.S. & Y.	BRONZE 280 Sc. Non-Rising 282 Sc. O.S. & Y. IRON 203A Sc. Non-Rising 203 Fl. Non-Rising 204A Sc. O.S. & Y. 204 Fl. O.S. & Y.
	SWING CHECK	BRONZE 352 Sc. Disc Type 762 Sc. Regrinding IRON 623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type	BRONZE 762 Sc. Regrinding IRON 338 Sc. Disc Type 339 Fl. Disc Type	BRONZE 260 Sc. Disc Type 962 Sc. Regrinding IRON 338 Sc. Disc Type 339 Fl. Disc Type
B	SOLUTION LINES GATE	IRON* 650 Sc. O.S.& Y. 651 Fl. O.S.& Y. 325 Sc. Non-Rising 326 Fl. Non-Rising 42A Sc. U-Bolt 43A Fl. U-Bolt ALL-IRON 95 Sc. Non-Rising 97 Sc. Non-Rising 98 Fl. Non-Rising 99 Sc. O.S. & Y. 100 Fl. O.S. & Y. 40A Sc. U-Bolt 41A Fl. U-Bolt	IRON* 277 Sc. O.S.& Y. 253 Fl. O.S.& Y. 251 Sc. Non-Rising 255 Fl. Non-Rising	IRON* 204A Sc. O.S.& Y. 204 Fl. O.S.& Y. 203A Sc. Non-Rising 203 Fl. Non-Rising
	SWING CHECK	IRON* Same as "A" above	IRON* Same as "A" above	IRON* Same as "A" above
	GLOBE	IRON* 612 Sc. Regrinding 613 Fl. Regrinding 141 Sc. Disc Type 142 Fl. Disc Type ALL-IRON 75 Sc. Iron Disc	IRON* 918 Sc. Regrinding 919 Fl. Regrinding 774 Sc. Disc Type 775 Fl. Disc Type	IRON* 922 Sc. Regrinding 923 Fl. Regrinding 162A Fl. Disc Type 162 Fl. Disc Type
C	DRAIN LINES GATE	BRONZE 47 Sc. Travel.Spind. 49 Sc. Travel.Spind. 370 Sc. Non-Rising IRON & ALL-IRON Same as "B" above	BRONZE 270 Sc. Non-Rising IRON 251 Sc. Non-Rising 255 Fl. Non-Rising	BRONZE 280 Sc. Non-Rising IRON 203A Sc. Non-Rising 203 Fl. Non-Rising

*Iron Body-Bronze Mounted Valves are also made in All-Iron Construction.

Stainless Steel Valves also available. Motor-operated Iron and Steel Valves can be supplied

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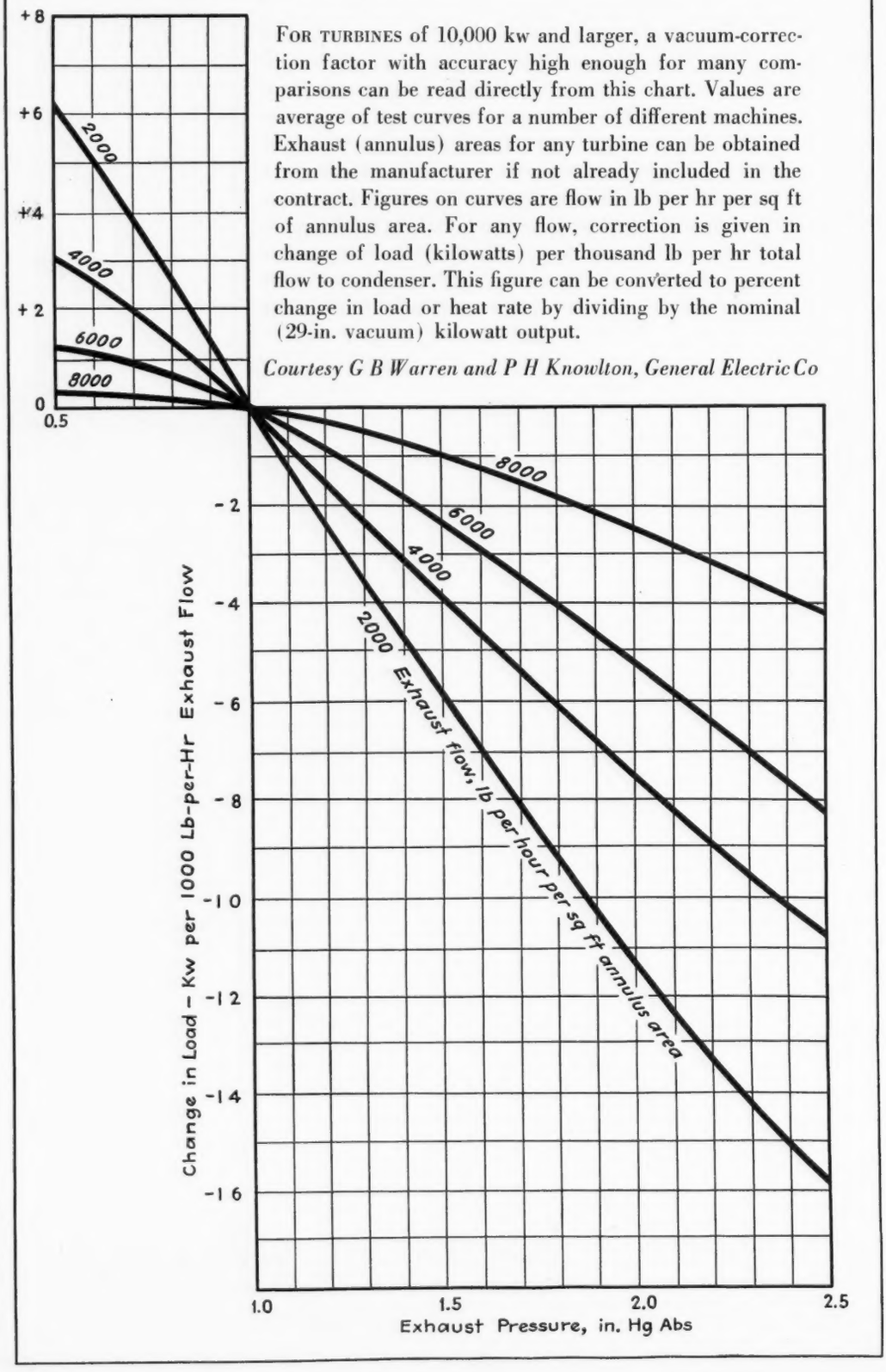
#21 OF A SERIES designed to help in your selection of JENKINS VALVES

Number 97

Turbine Vacuum-Correction Factor

FOR TURBINES of 10,000 kw and larger, a vacuum-correction factor with accuracy high enough for many comparisons can be read directly from this chart. Values are average of test curves for a number of different machines. Exhaust (annulus) areas for any turbine can be obtained from the manufacturer if not already included in the contract. Figures on curves are flow in lb per hr per sq ft of annulus area. For any flow, correction is given in change of load (kilowatts) per thousand lb per hr total flow to condenser. This figure can be converted to percent change in load or heat rate by dividing by the nominal (29-in. vacuum) kilowatt output.

Courtesy G B Warren and P H Knowlton, General Electric Co



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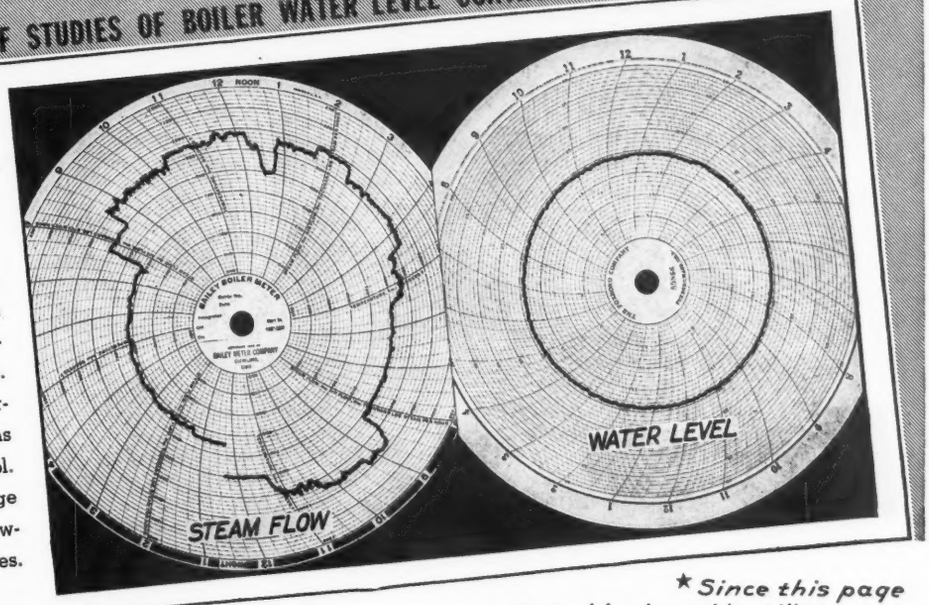
NO. 5 IN A SERIES OF STUDIES OF BOILER WATER LEVEL CONTROL WITH COPES FLOWMATIC

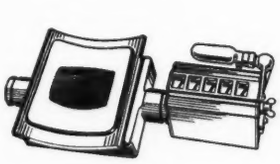
875 POUNDS W. S. P.

Powdered coal firing. 875-lb. 860-deg. Foster-Wheeler 3-drum boiler. (Plant name on request). Maximum evaporation, 400,000 lb. per hour. Normal, 330,000 lb. Motor-driven centrifugal pump has no automatic pressure control. Extreme water level range permitted by COPES Flowmatic Regulator is 1.6 inches.



★ *Since this page appeared in June this utility system has ordered COPES Flowmatic for its 6th plant.*

★6 plants in this utility system are getting control like this



COPES COAL COUNTER

Gives accurate, continuous reading of how much coal is fed each stoker. Inexpensive to buy, install and operate. Large lighted dial easily read 30 feet away. Only a soft rubber roller, highly resistant to abrasion, comes in contact with the coal. Measurement continues accurate much longer than if it depended on any wearing part in, or touching, the abrasive material. Nothing to stick or break off and cause "bridging" of coal in pipe. Write for Bulletin 411.

Promises might sell a first order, but no progressive utility system repeats with any equipment until it has made good on the job. And the COPES Flowmatic Regulator has done just that with this system. Since 1937, when its first Flowmatic was installed, five plants have bought this simplified steam flow type feed water regulator for new 875-pound boilers. All are getting close water level control, with feed flow exactly as needed for the steaming conditions. None have had any particular operating or maintenance problems. If you want effective feed and level control on your modern boilers, specify the COPES Flowmatic. Write for Bulletin 429.

NORTHERN EQUIPMENT CO., 801 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves
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★ GET CLOSER LEVEL CONTROL WITH THE FLOWMATIC

POWER LINES

A Word to the Wise Coal Buyer

How big is your industrial coal pile? Reestablishment of the 100% "no-bill" rule by the railroads, effective July 15, again runs up a warning signal to dilatory buyers. Developed mine capacity, as the National Coal Association assured the President last month, is ample to take care of increased demands for soft coal and there is no shortage of labor. But, as in the last World War, the transportation machine may be the bottleneck in the flow of coal from mines to consumers.

Under the rule invoked by the Association of American Railroads for the third time since last September, no open-top cars will be placed at mines where the number of unbilled loads being held equals or exceeds the daily rated capacity of the mine. Because demand for the different sizes of coal necessarily produced in a day's run is seldom, if ever, in equilibrium, it is customary to hold the unwanted sizes in cars at the mines. Under the "no-bill" rule, as soon as the number of such loads reaches the mine rating, the operation will be compelled to shut down for lack of car supply—or dump the coal on the ground or on a reluctant market. Shutdowns now may have serious repercussions later.

Bituminous production and storage stocks have been running well ahead of last year. But output and storage the first half of 1939 were affected by the six weeks' strike in the Appalachian region. A better comparison would be with 1937. During the first half of 1937, output closely approximated the 220,504,000 tons mined the first six months of this year. Stocks in the hands of industrial consumers as of June 1, 1937, totaled 38,169,000; a month ago they were 32,449,000 tons; consumption for the first five months of 1937 was 29,377,000 tons; for the first five months of 1940 it was 25,787,000 tons. And no major national-defense program in 1937 swelled activities in the heavy industries.

At present the bituminous mines are holding about 35,000 unbilled loads. Practically all of this is industrial coal. Current consumption, it is estimated, is running close to current production and the June reserve stocks represented only a 39 days' supply at present consumption rates. Demand for open-top equipment for steel, ore, sand, gravel and scrap iron is increasing; meeting this demand is eating into the equipment supply which otherwise might go to the mines.

More Air Conditioning for Industrial Rayon

Industrial Rayon Corp has awarded the contract for the largest centrifugal refrigerating machinery in the United States to the York Ice Machinery Corp. With a capacity of 1000 tons of refrigeration, the machine, a York-Allis-Chalmers turbo-compressor, in combination with a York brine-cooling system, is also said to be the world's largest single-unit refrigerating system using the refrigerant Freon-11. The system will be used for industrial process air conditioning in an addition to present plant at Painesville, Ohio.

Feature of the unit is its steam-turbine drive, which will be completely automatic in operation. Exhaust steam from the generating turbines will be used as a source of power. 4000 gallons of Lake Erie water will be used every minute in condensing the refrigerant gases, cooling 2600 gallons of brine per minute to 40 deg. The new equipment will be interconnected with the present brine-cooling system to allow flexibility in using steam or electric power to drive the refrigerating systems.

FEDERAL POWER COMMISSION

—Harris & Ewing Photo

Federal Power Commission as now constituted. Left to right: John W Scott, Basil Manly, Leland Olds, Claude L Draper, vice-chairman, and Clyde L Seavey, chairman

MEETINGS

American Institute of Electrical Engineers —*Pacific Coast Convention, Los Angeles, Calif, August 26–30, H H Henline, secretary, 29 W. 39th St, New York, N. Y.*

American Society of Mechanical Engineers —*Fall Meeting, September 3–6, Hotel Davenport, Spokane, Wash. C E Davies, secretary, 29 W 39th St, New York, N. Y.*

Association of Iron & Steel Engineers— *National Convention, September 24–27, Chicago, Ill. Brent Wiley, managing director, Empire Bldg., Pittsburgh, Pa.*

National Association of Power Engineers —*National Convention and Mechanical Exposition, August 19 to 23, Auditorium, Columbus, Ohio. National Secretary, Fred W Raven, 176 W Adams St, Chicago, Ill.*

National Electric Mfrs. Assn. — *Annual Meeting, October 27–November 1, Waldorf-Astoria Hotel, New York, N. Y. W J Donald, director, 155 East 44th St, New York, N. Y.*

New York Power Show—*Grand Central Palace, New York, N. Y., December 2–7, 1940. Management, International Exposition Co, New York, N. Y.*

Georgia Power Co Adds 60,000-kw Turbine-Generator

Georgia Power Co has ordered a 60,000-kw turbine-generator for Plant Atkinson. The new turbine will duplicate the present equipment in the plant, and at the same time include improvements made recently in turbine design and construction. The new 17-stage unit will operate at 1800 rpm and drive a 66,667-kva, 13,800-volt, 60-cycle generator. It is designed for steam conditions of 425 lb pressure and temperature of 725 F, and 2-in. abs backpressure.

Windsor Tops Again

Windsor Station, owned jointly by Ohio Power Co and West Penn Power Co, was topped in 1937 by the former, and will be topped by West Penn this year. The first topping installation was two 750,000-lb-per-hr boilers supplying steam at 1250 lb, 925 F, to a 60,000-kw turbine-generator, which in turn exhausts at 235 lb to three 30,000-kw existing turbines.

A 60,000-kw topping turbine-generator was ordered by West Penn at that time for its half of the station, but installation was delayed until May of this year, when an order was placed with Combustion Engineering Co for two high-pressure boilers to serve this generator and the other three 30,000-kw existing low-pressure turbines. These boilers will be 3-drum, bent-tube type, designed for an output of 750,000 lb each at 1525-lb drum pressure and 925-F total steam temperature. They will be

(Continued on page 150)

Water Velocity?
Condenser Design?
Temperature?
Water Conditions?
Presence of Air?

Which condenser tube alloy is best for *your* combination of these variables?

THERE is such a complication of operating factors having an influence on the service life of condenser tubes that no one tube alloy can possibly solve all problems.

To determine the tube alloy that will give the greatest service per dollar of cost requires metallurgical experience and practical knowledge of specific operating conditions. So we suggest that you take advantage of the experience of our Technical and Engineering Departments. They can place before you performance records of copper alloys under operating conditions similar to your problem. No charge is made for such consultation. 40111

ANACONDA TUBE SHEETS—We produce a complete line of plates and circles for marine and stationary condensers, heat exchangers, feed water heaters and oil coolers. The same careful technical supervision used to control the manufacture of Anaconda Condenser Tubes is given this material during the entire process of production.

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THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Connecticut

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Saving is Having . . .

ONE OF FRED LOW'S favorite stories was about the engineer who answered an advertisement in POWER. The ad called for a chief engineer for a plant in Fall River, Mass., so the job hunter traveled up there to see the company president. After he had supplied references and a detailed story of his experience, the president broke the sad news that the job would pay just $100 a month.

"But I have a wife and two children," explained the job seeker, "I don't think we could live on that."

"That's all it pays," said the president, flatly.

"Well, then, I think I'll have to pass it up," said the job seeker, "but before I leave, do you mind if I take a walk through the plant?"

"Not at all," replied the president.

A half hour later the job seeker was back. "Say," he said, without preamble, "I'll take that job for nothing, if you'll let me keep what I save on operating costs!"

"Nothing doing!" yelled the president. "I might have to pay you double what I offered!"

That kind of short-sighted management is still all too common. In dozens of plants, power engineers are fighting to keep equipment going that should have been scrapped years ago—because they can't convince their executives that the investment will pay real dividends. In dozens of plants, too, the power department is considered to be a necessary evil, and chance after chance is missed to make a worthwhile saving.

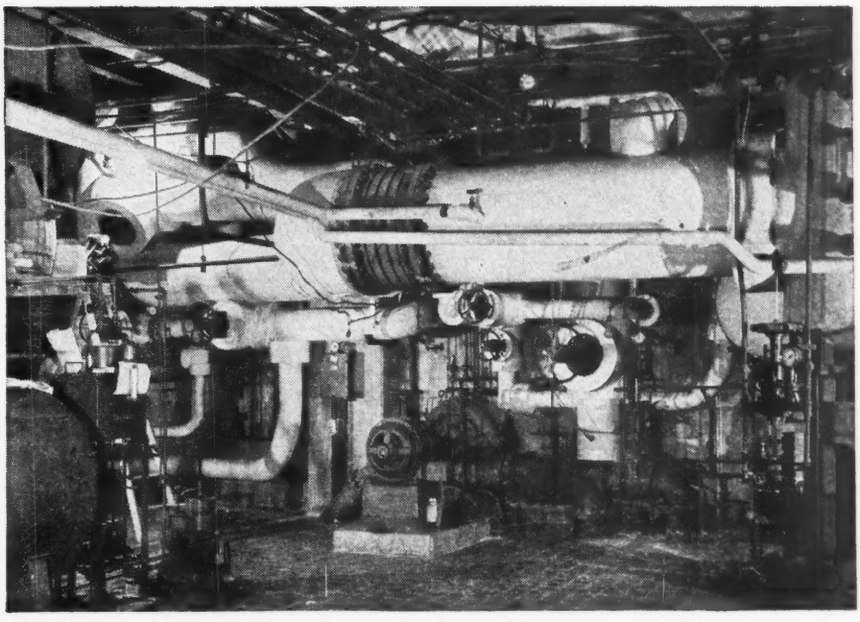
Seems like, sometimes, that managers can't believe a penny saved is just as good as a penny earned. They continue to starve service departments—and lose thousands of dollars—while they battle to make fractional-cent savings in production departments. Like the bargain-store proprietor, they yell, "Sure, we're losing a little on every sale, but look at the business we're doing!"

Perhaps part of the fault lies with us engineers. Do we have adequate and convincing records of steam and power costs? Are inputs and outputs metered and recorded? In many cases, the place to start a modernization and cost-saving campaign is with the little, inexpensive changes—the installation of metering and recording units that give a real basis for savings. Any executive, no matter how deaf, can always hear the eagle shriek.

George Edwards

Engineer

DOES YOUR INSULATION INVESTMENT PAY A *FULL* RETURN?



On Furnaces where insulation is required to resist temperatures up to 1900° F., J-M Superex is widely recognized as the most efficient block insulation available today. Hundreds of installations under all types of operating conditions prove its long life and low maintenance.

For Temperatures Up To 600° F., you save by using J-M 85% Magnesia. For years the standard material for insulating power-plant equipment and steam lines, it combines light weight with permanently high insulating efficiency.

HOW much money you spend on fuel depends to a large extent on the answers to these two questions:

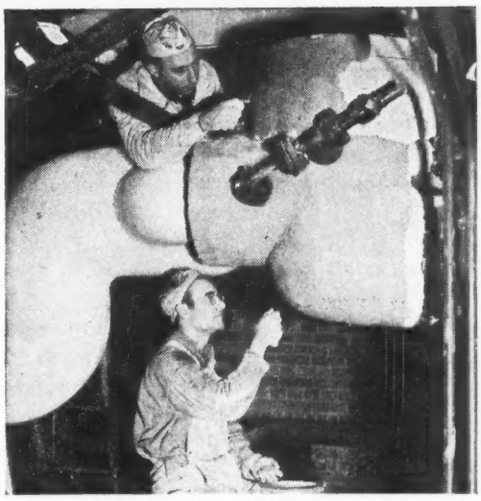
Are you using the *correct insulating materials?*

Are they applied in the *correct thicknesses?*

To assure every saving possible with insulation, it will pay you to call in a J-M Insulation Engineer. Let him study your requirements . . . his specialized technical training and experience will help you trace down and correct sources of heat waste that may otherwise go unnoticed.

From the complete line of J-M Insulations, he can recommend exactly the *material* you need for greatest efficiency . . . exactly the *thickness* you need for maximum returns.

For full details on this helpful service and facts about the complete line of J-M Industrial Insulations, write to Johns-Manville, 22 East 40th Street, New York, N. Y.



On Superheated Steam Lines, J-M Superex Combination Insulation effectively guards against costly heat waste. Built up of an inner layer of Superex and an outer layer of 85% Magnesia, this combination assures maximum heat resistance and insulating efficiency.

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FOR EVERY TEMPERATURE . . . FOR EVERY SERVICE . . .

Superex . . . 85% Magnesia . . . JM-20 Brick . . . Sil-O-Cel C-22 Brick . . . Sil-O-Cel Natural Brick . . . J-M No. 500 Cement . . . Sil-O-Cel C-3 Concrete . . . Marinite

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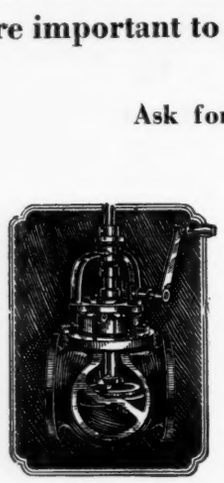
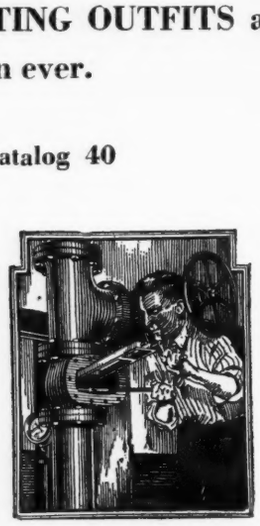


FOR GLOBE VALVES



FOR GATE VALVES

THE LEAVITT MACHINE COMPANY

ORANGE, MASSACHUSETTS

Distributors are also invited to investigate the possibilities in DEXTER VALVE RESEATING OUTFITS and SWENDEMAN AUTOMATIC AIR SEPARATORS.

Carolina Circuit

(Continued from page 93)

tion, also spoke briefly at the evening session.

Tennessee Eastman is another one of America's great process establishments, a plant that completely upsets the Northerner's preconceived notion of a Southern "mill." Nothing more modern can be found in the country. Steam and kilowatt capacity are impressive.

After a much needed night's rest in the Torok home in Elizabethton, I trailed Mr Torok on an inspection tour through the plants of North American Rayon and American Bemberg. For policy reasons I am not able to give any engineering details, but can state that these are splendid big plants, employing a total of about 8000 workers. Mr Torok is in charge of all steam, power, refrigeration and air-conditioning for both. The job keeps him mighty busy. He is the author of several books on radio and air-conditioning.

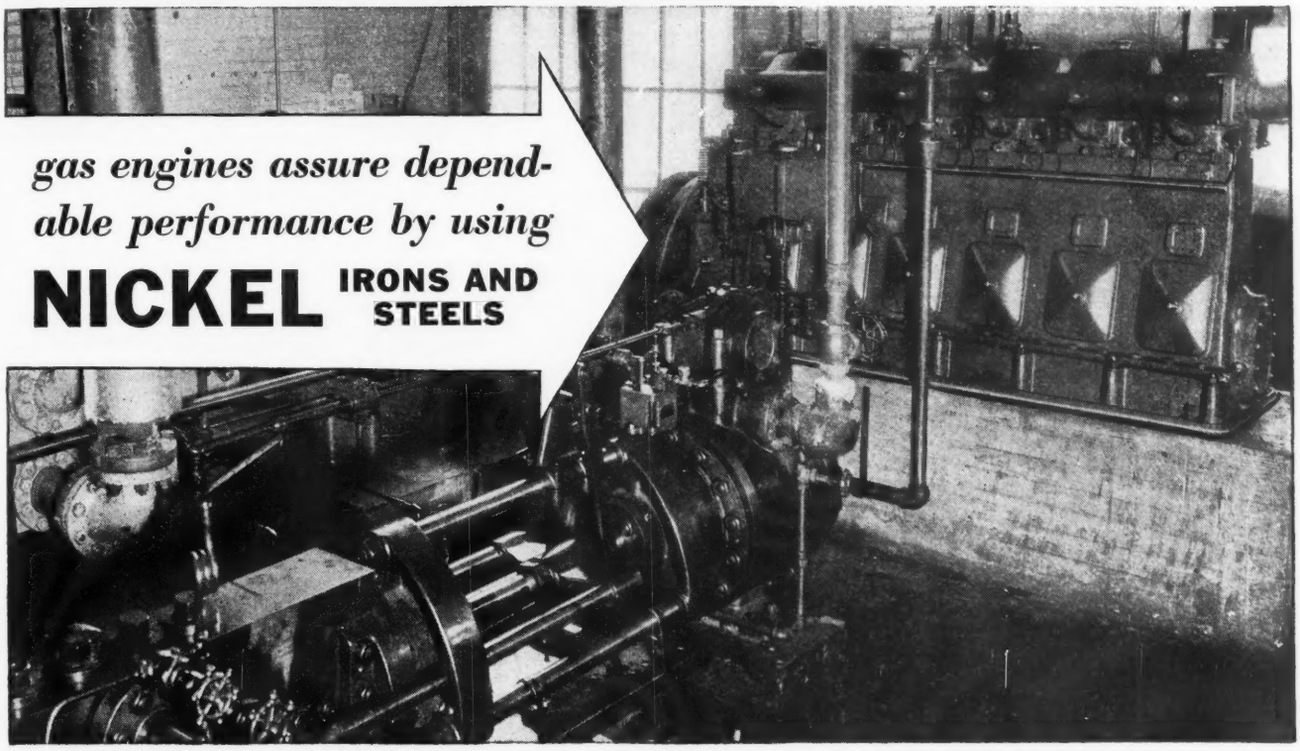
Spruce Pine, Asheville

Driving back to Asheville on Sunday, we stopped to have chicken dinner with Mr and Mrs S T Henry, and daughter, in Spruce Pine, N. C. Mr Henry, who is connected with McGraw-Hill in an executive capacity, is now practically commuting between Spruce Pine and the big cities in the North. He flies down here to spend an occasional week-end in his farm house at 4,000-ft elevation. Here, as a resident of many years, he is at home with his dairy farm, his local newspaper, movie and other town activities.

You might call Monday, May 20, the last working day of this Southern trip. In the morning I paid a brief visit to B P Krick, plant engineer in American Enka Corp's great rayon plant at Enka, on the outskirts of Asheville. Here again I am not at liberty to give technical details regarding the plant. I should note, however, that Enka is one of the most splendid industrial establishments to be found in America.

In the evening, back in Asheville, I was speaker at a joint dinner meeting of the Greenville (S. C.) section of the ASME and the Western North Carolina Engineers Club. Those present included a fine bunch of engineers from the plants and institutions of the region—for example, Enka, Champion Fibre & Paper, Biltmore Bleacheries, Ecusta Paper Corporation, Clemson College, etc. Many drove up from Greenville, South Carolina.

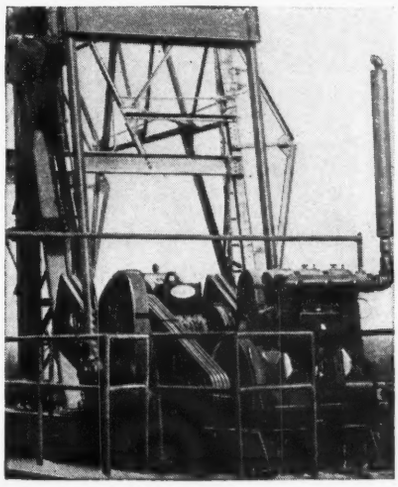
RUGGED TRANSIT



gas engines assure dependable performance by using

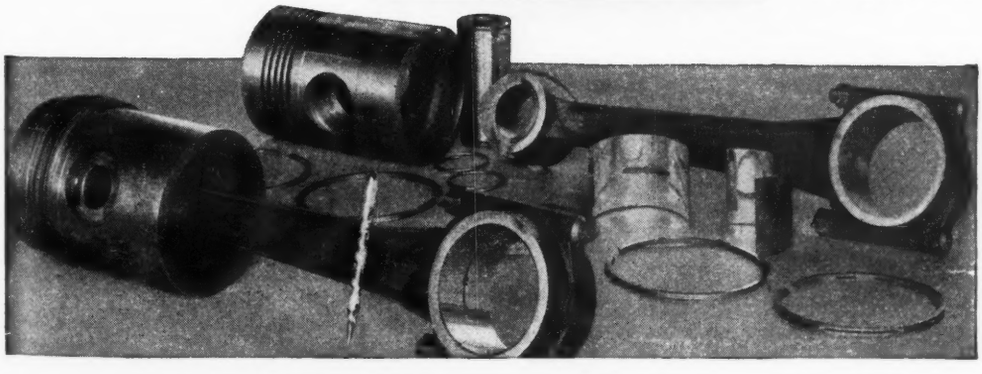
NICKEL IRONS AND STEELS

Transit vertical gas engines, moderate speed units for heavy duty, stand up under severe service and operate continuously for long periods of time. This 6-cylinder 6″ x 9″ Transit engine serves a Western Pennsylvania refinery. From Nickel-chromium steel main bearing studs, SAE 3140, to Nickel cast iron liners, heads and pistons, Transit engines are made more rugged by using Nickel to strengthen and toughen metals.



This 3-cylinder 6″ x 9″ Transit gas engine is pumping with a Lufkin Twin. For strength where the stress comes, Transit engineers have long specified Nickel alloy steels and Nickel cast irons. Nickel alloyed materials withstand stress and fatigue, and stubbornly resist wear.

These pistons, cast in the Oil City, Pa. works of the National Transit Pump and Machine Co., are 1.00/1.50% Nickel iron with a high tensile strength. Cylinder heads contain 1.00% Nickel, cam shaft sprockets, 1.50%. Cylinder liners are centrifugally cast from a Nickel-chromium-molybdenum composition to a hardness of upwards of BHN 200. Connecting rod bolts are of SAE 2330 3½% Nickel steel providing tensile strengths up to 115,000 p.s.i. You're always safe, and usually money ahead, when you specify Nickel alloyed metals for the hard jobs.



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MASON REGULATOR CO., OF CANADA, LTD., MONTREAL, CANADA

New Plant Equipment

(Continued from page 122)

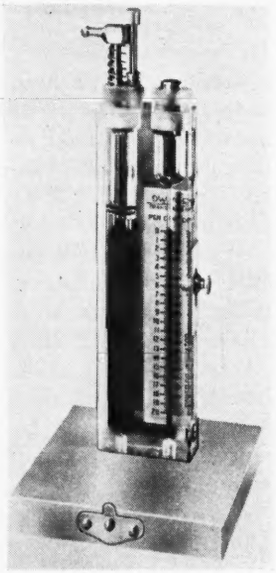
electric pickup inside clock is arranged to give equally-spaced and uniform signals to time-error differential device. This device is a system of gears which acts to correct any errors in timing between master clock and electrical system, by applying proper bias to point-centering springs. Load-division regulators are the same as frequency regulators except that they are responsive to active power, rather than frequency. Accessory equipment includes transformers, reversing switches, transfer switches and resonant filter.

Burlington Instrument Co, 301 N Main St, Burlington, Iowa

CO_2 Indicator

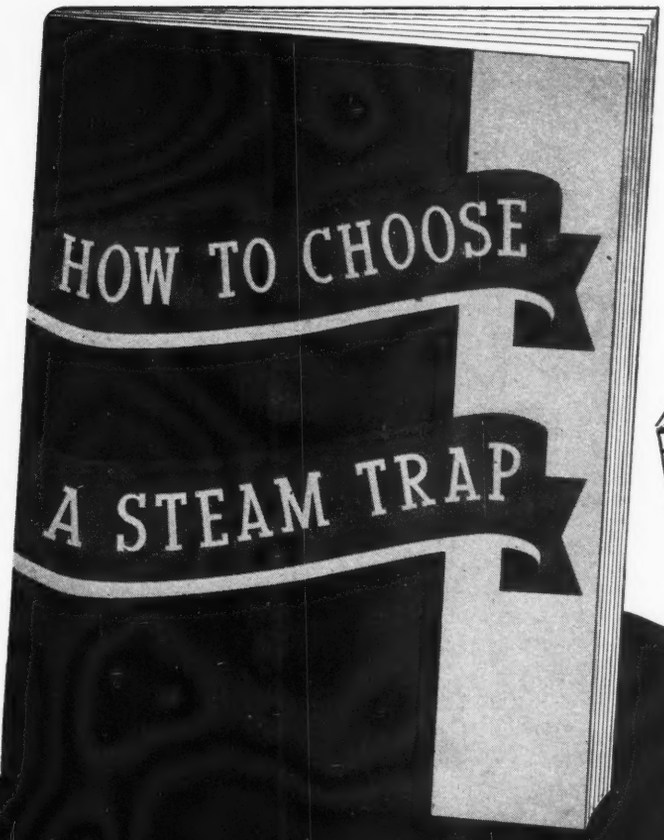
DWYER pocket CO_2 indicator is of unbreakable, transparent, plastic construction. Carrying case has built-in compartments for draft gage and thermometer, and self-closing valves prevent loss of absorbent solution. Analyses are run by holding inlet plunger down while pumping the sample in and raising and lowering the absorption unit.

F W Dwyer Mfg Co, 565 W Washington Blvd, Chicago, Ill.



Flow Switch

MCDONNELL flow switch employs positive mechanical action to start a pump, alarm or any electrical device when flow through a pipe starts or stops. Consists of long flexible paddle which is extended into pipe. When this paddle is forced back by flow in pipe, it closes electrical circuit and starts whatever machinery switch controls. When flow through pipe stops, paddle returns to normal position, breaking electric circuit. Reversing switches also available. Paddle itself is flexible and will pass stone or debris through pipe. Can



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How to choose the right size of trap • How to maintain a false water line • When to use a return trap • How to get instant heat • Trap sizes for unit heaters • How to trap an autoclave • What trap to use on steam separators removing oil, etc. • Have a copy at your fingertips—send the coupon today.

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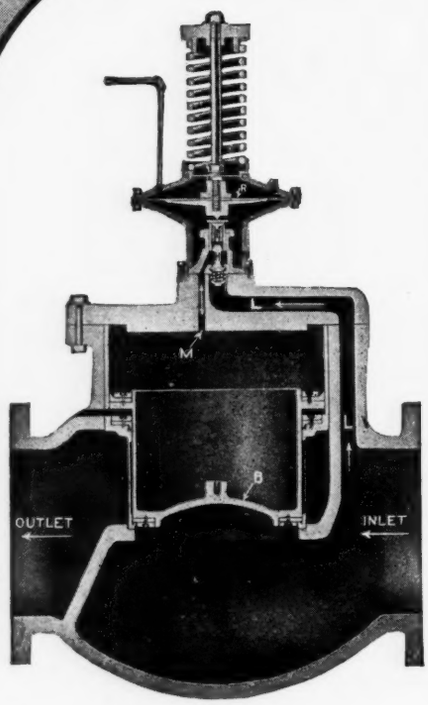

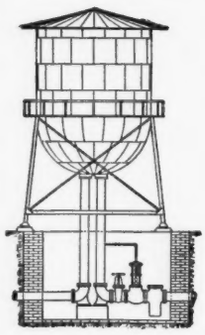

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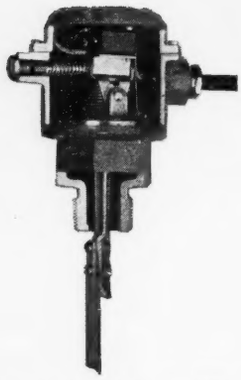
also

Emergency Throttle . . . Float Control . . . Pressure Reducing . . . Triple Acting Non-return . . . Check Valves . . . Etc.

Golden-Anderson Valve Specialty Co.

Fulton Bldg. • • • Pittsburgh, Pa.



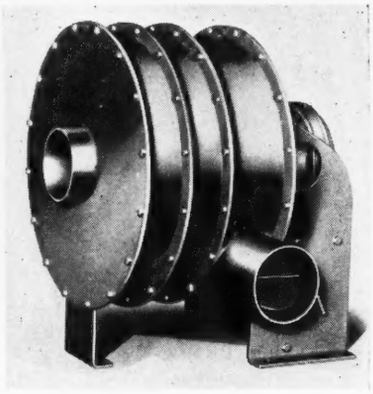
be cut to any length to fit different sizes of pipe, and it is said that paddle will not interfere with high rate flows. Paddle arm is connected to electric switch through flexible metal bellows which keeps switch waterproof.

McDonnell & Miller, Rm 1305, Wrigley Bldg, Chicago, Ill.

Motor Blower

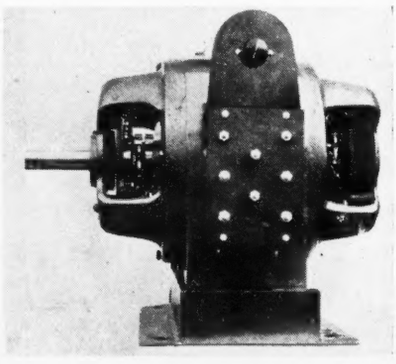
TYPE G MOTORBLOWER, for furnishing air to oil- and gas-fired furnaces, requires no special foundation. Built-in blast gate is located in blower discharge and flexible pipe connection are provided for connecting either intake or discharge to shop piping. Unit available in 72 sizes, with discharge opening on all sizes located in any one of 8 positions, in steps of 45 deg.

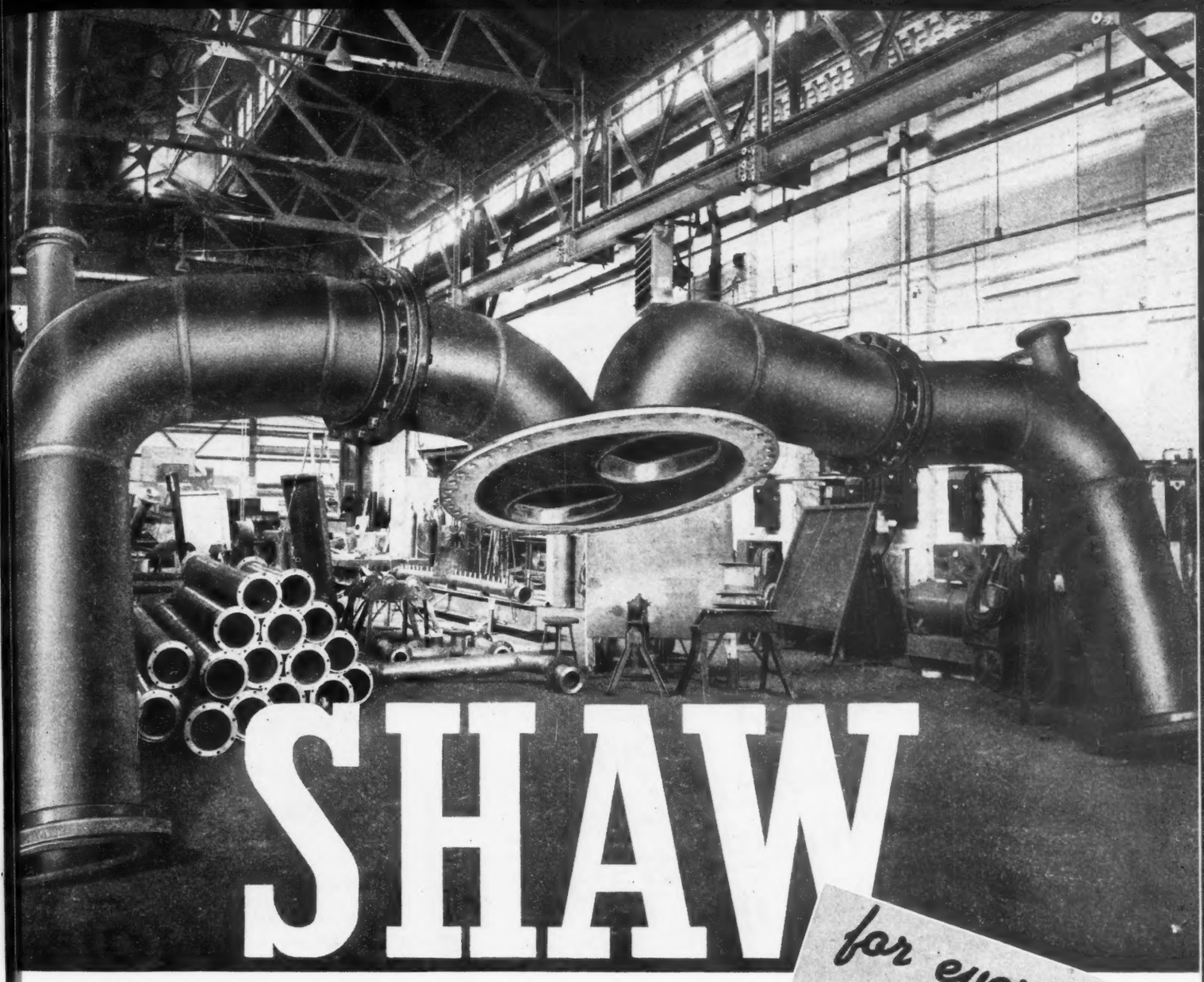
Ingersoll-Rand Co, Phillipsburg, N. J.



Power Converter

KATOLIGHT dc motors operates both as dc motor and provides ac current for small jobs. Motor is built with slip-rings for





SHAW

for every type of Intricate

PREFABRICATED PIPING

for Power and Industrial Plants

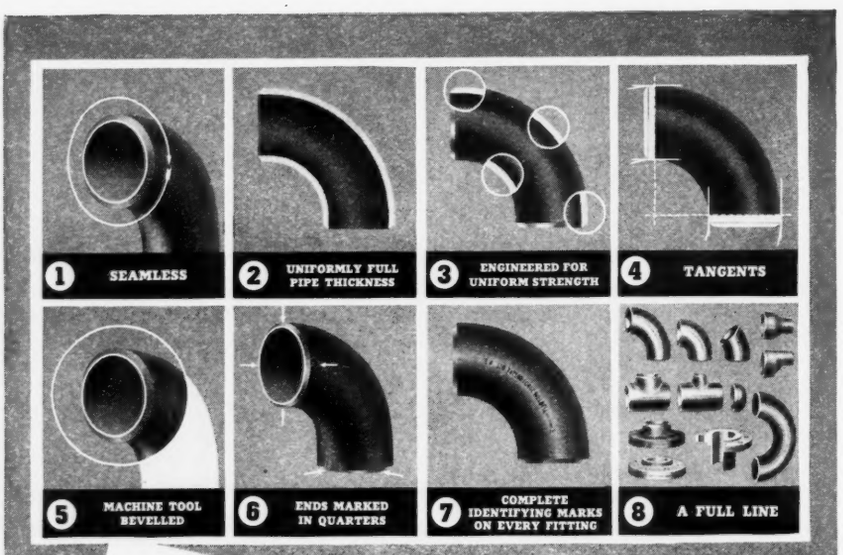
Typical of Benjamin F. Shaw Co.'s specialized ability in executing capably, intricate prefabricated piping, is this Exhaust Steam Header, of three pieces. It is 24″ pipe, 19 feet wide overall and 7 feet high.

Whether your prefabricated piping job is intricate or simple, large or small, for high or low pressure, the Shaw plant is equipped to handle it efficiently, economically—and deliver it promptly. Write or call us.

BENJ. F. SHAW COMPANY

2nd & Lombard Streets, Wilmington, Delaware

PIPING FABRICATORS AND CONTRACTORS


1 SEAMLESS
2 UNIFORMLY FULL PIPE THICKNESS
3 ENGINEERED FOR UNIFORM STRENGTH
4 TANGENTS
5 MACHINE TOOL BEVELLED
6 ENDS MARKED IN QUARTERS
7 COMPLETE IDENTIFYING MARKS ON EVERY FITTING
8 A FULL LINE

DON'T CONFUSE welded pipelines with WeldELL pipelines. WeldELLS alone offer ALL these eight aids to better, safer welding.

TAYLOR FORGE

WeldELLS

Seamless Pipe Fittings for Welding

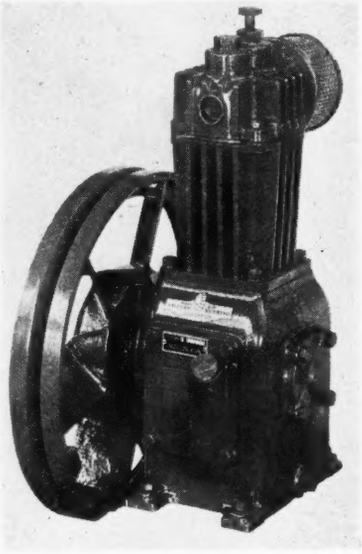
TAYLOR FORGE & PIPE WORKS
General Offices and Works: Chicago, P. O. Box 485
New York Office: 50 Church Street
Philadelphia Office: Broad St., Station Bldg.

ac take-off on one end. Typical application of unit is on spot-welding transformers, when used in direct current areas.

Kato Engrg Co, 101 Elm St, Mankato, Minn.

Air Compressors

SUPPLEMENTING present line of large compressors, Type Q is used for small services, diesel starting, etc. Units have cushioned air valves, tapered roller main bearings, Lynite connecting rods, semi-steel pistons, and automatic starting. Latter is optional. Available base-mounted,



bare, or tank-mounted, for V-belt drive from motor or air-cooled gasoline engine. Units for diesel starting have combination motor and gasoline drive, so arranged that belt can be shifted easily to gasoline engine in case of power failure.

Sullivan Machinery Co, Michigan City, Ind.

AC Welder

ARCMASTER welder features multiple-coil transformer design said to assure even flow of current to electrode, improved safety construction, and low cost. Either ground

"In this tremendous national task of the next two, three or four years — perhaps more — your major duty as a Power Engineer is obvious — to keep industry's wheels turning, juice always on the line, process steam and other services on tap.

"Power engineers of industrial plants making, or likely to make essential war products, should check their power service spares and stand-by capacity with a view to probably two- or three-shift operation—possibly seven-day operation as well.

"Will you have enough dependable spare capacity to permit routine repair and maintenance without endangering continuous operation? Is everything shipshape, with decks cleared for action? A careful check now becomes a matter of both patriotic duty and of simple common sense."

★ ★ ★

As a matter of "simple common sense" — are *your* boiler interiors capable of withstanding the continuous operation of an emergency?

A careful check now will do much to avoid costly outage later.

APEXIOR — brush applied to tubes and drums forms an intimate bond with boiler metal — protecting against corrosion and preventing chemical adherence of scale.

BOILERS STAY CLEAN LONGER.

BOILER INTERIORS CLEAN EASILY.

Cost? — material for a standard maintenance single coat averages only 1¼¢ per square foot.

APEXIOR provides the only really stable factor approaching a guarantee of BOILER PREPAREDNESS under all kinds of feedwater.

Send for bulletin 1300. It's your first step in preparing for heavy boiler requirements.

ADDS CORROSION RESISTANCE—KEEPS BOILERS CLEAN LONGER—MAKES BOILER CLEANING EASIER

APEXIOR REG U.S. PAT. OFF.

CERTIFIED IN SERVICE BY ITS USERS

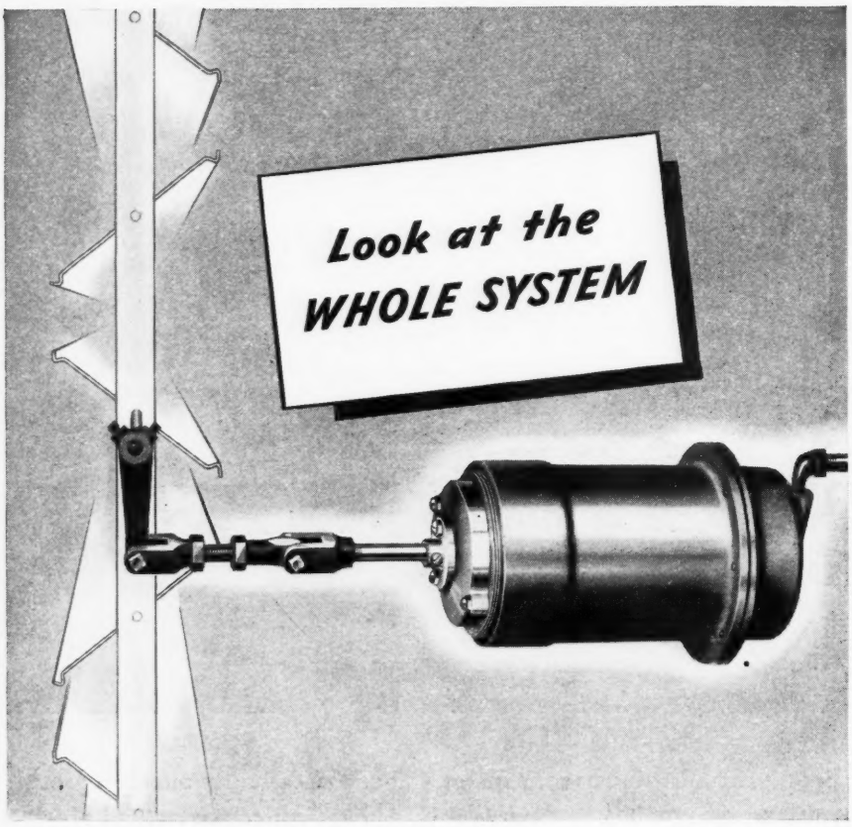
THE DAMPNEY COMPANY OF AMERICA

PROTECTIVE COATINGS FOR STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

HYDE PARK · BOSTON · MASSACHUSETTS

Atlanta Chicago New York Detroit Philadelphia

Engineering Sales Representatives — Pittsburgh, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Houston, Vancouver, B.C., Montreal, P.Q., Havana, Cuba, Manila, P.I., Honolulu, T.H., Marine Dept., 114 Liberty St., New York, N.Y.



JOHNSON'S *"LONG TRAVEL"* DAMPER MOTORS
improve the entire automatic control installation

Johnson "Piston Type" Damper Motors are a new departure in units for moving dampers. This unique device, emphatically *not* just another valve operator adapted to other service, is engineered especially to perform the particular work of controlling dampers gradually. Designed from that viewpoint and tested in actual service, these Johnson "long-travel" motors improve the whole automatic control installation. More power! More movement! Greater simplicity! G-R-A-D-U-A-L control!

These devices satisfy another of the definite requirements of the air conditioning and process control industries. They furnish one more evidence of the ingenious development and unique design which characterize modern Johnson temperature control systems . . . Send for Bulletin D-251 which describes Johnson Piston Type Damper Motors or Bulletin D-261 which includes the Johnson Pilot Mechanism, where exact repositioning is required.

JOHNSON CONTROL IS THE "BRAIN" OF THE AIR CONDITIONING SYSTEM

The "long travel" feature of JOHNSON Piston Type Damper Motors is desirable where gradual positioning of automatically controlled dampers is required.

Direct connection between motor and damper means maximum power. Ordinary damper motors require levers, appreciably reducing the useful operating force.

Pilot mechanism, not illustrated, is optional. Smooth gradual operation, independent of friction, air velocities, and other variations.

Another important member of the distinctive line of JOHNSON devices for gradual control that IS G-R-A-D-U-A-L. Similar to JOHNSON "Streamline" valves.

JOHNSON
Automatic TEMPERATURE AND AIR CONDITIONING ***Control***
JOHNSON SERVICE COMPANY, MILWAUKEE, WIS. & BRANCHES IN PRINCIPAL CITIES

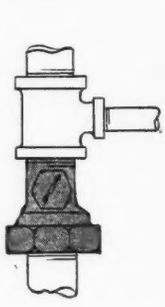
or welding leads can be connected with any input wires without completing electrical circuit. Circuit on output cannot be completed till actual welding takes place. Unit is furnished in three models with ranges of 10—200 amp, 10—250 amp, and 10—300 amp. All models have 220, 60-cycle voltages. Each unit includes 20-ft ground cable, 20-ft electrode cable, head shield, rod-holder and assortment of rods.

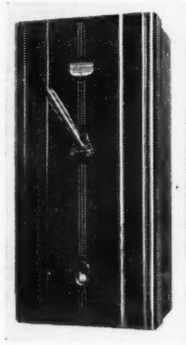
Bear Mfg Co, Rock Island, Ill.

Blowoff Muffler (below, left)

CENTRIFUGAL BLOWOFF muffler said to eliminate disadvantages of blow-off tank. By its use, according to maker, steam can be vented in boiler room or outside through sheet-metal pipe, and water can be released through open floor drain to sewer connections. Blowdown, on entering inlet of muffler, sets up centrifugal action which separates sludge and water, and permits vapor to rise and drift out through the vent. Swirling action keeps muffler clear of sludge and sediment. Outlet of muffler always being open said to prevent building up of dangerous pressures.

Sullivan Valve & Engrg Co, 910 South Arizona St, Butte, Montana





Line Starter (above, right)

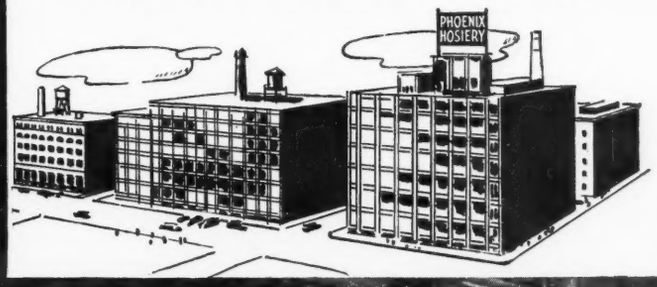
IMPROVEMENTS in across-the-line starter for control and protection of polyphase squirrel-cage motors are: (1) Streamlined cover can be removed for easy installation. Interior of case is finished in light aluminum to aid in making connections. (2) Loosening of one screw permits removal of operating mechanism for easy wiring and conduit work. (3) Contacts are of heavier silver. Lava insulators protect contact springs against heat transmissions. (4) C-H overload relay has been made smaller in size, more accessible, with better operating characteristics. Further improvement is overload trip indication.

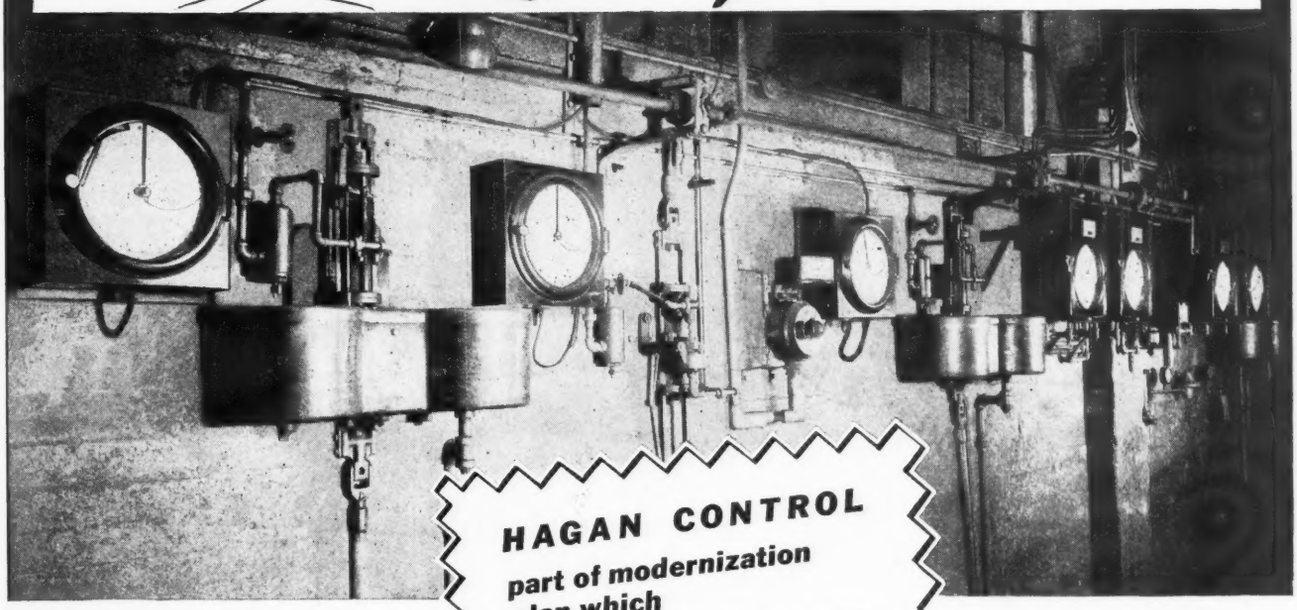
Cutler-Hammer, Inc, 606 N 12th St, Milwaukee, Wis.

Motor Winches

SACO winches have several new features. New winch is furnished in variety of sizes to handle small or large capacities. One new feature is jaw clutch which releases pulling rope when disengaged. While formerly it was necessary to run winch in reverse direction to pay out rope, clutch can now be disengaged and rope paid out

PHOENIX HOSIERY TURNS AN OLD POWER PLANT INTO A "Gold Mine"





HAGAN CONTROL part of modernization plan which

SAVED $41,867 A YEAR

DOUBLED CAPACITY OF UNITS

ELIMINATED 1 BOILER PLANT

PART OF Hagan Combustion Control System, Furnace Draft Controllers and Receiving Regulator, which helped save over $8,600 in the plant of Phoenix Hosiery Company. As the cost of fuel is the largest item in the total cost of power plant operation, efficient combustion control is of vital importance. Hagan Control is noted for its efficiency, speed, sensitivity, power and stability.

DOES power plant modernization pay? Phoenix Hosiery Company discovered it does. Through a long-range modernization program, they changed an old, wasteful power system into an efficient plant that quickly paid for the improvements.

The following plan was adopted: (1) Remove scale from boilers. (2) Replace all piping in plant No. 1 with new standard piping. (3) Install automatic combustion control with the necessary instruments. (4) Rebuild furnaces and install water-cooled arches in plant No. 1. (5) Shut down plant No. 2 with the exception of one engine and a motor-generator set.

The Hagan control and instruments included in the modernization program alone effected a coal saving of 1727 tons per year, or $8635 — 21% of the total savings achieved. It took only 15 months to pay for this equipment which, according to plant engineers, has been earning handsome dividends ever since.

Let us help you make YOUR plant pay similar dividends. Our 25-year-old files are crammed with instances in which Hagan control paid for itself shortly after installation and then went on to effect substantial fuel savings — REAL operating economies.

We'll gladly send an experienced Hagan engineer to study conditions in your plant. Just call or write.

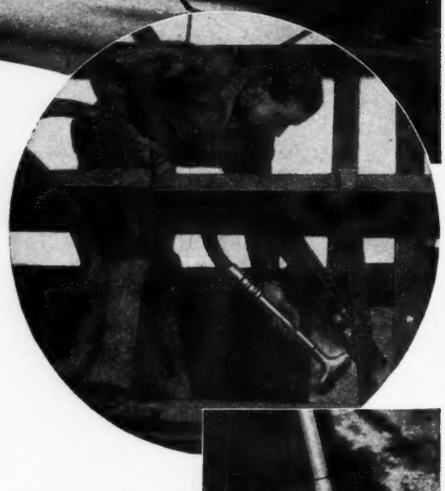
HAGAN CORPORATION 300 ROSS ST. PITTSBURGH, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

ADVERTISING PAGES REMOVED

The Spencer Portable shown at the bottom of the page cleans this large foundry.



ARE DIRT AND REFUSE EATING UP PROFITS *in your plant?*

Every plant has a dirt problem. The cost of removal is as much as 5% of the finished product in some plants. Furthermore, health and insurance regulations in most states now require thorough and regular cleaning.

Fortunately for industry, there is a method of removing dirt that is not only thorough, but that pays for itself, because it is cheaper than cleaning by hand methods.

SPENCER VACUUM CLEANING is the fast efficient method that has been making rapid strides in industry during the past ten years.

It Cleans	It Reclaims	It Removes
FLOORS	CHEMICALS	GRIT
LEDGES	FUEL	LINT
MACHINERY	METALS	PAPER
PIPES	RUBBER	POWDER
WALLS	SAND	VERMIN

It is powerful enough to remove tons of sand, yet exacting enough for a watch factory, and is made in a range of sizes from ¾ to 100 HP that makes it economical for any size plant.

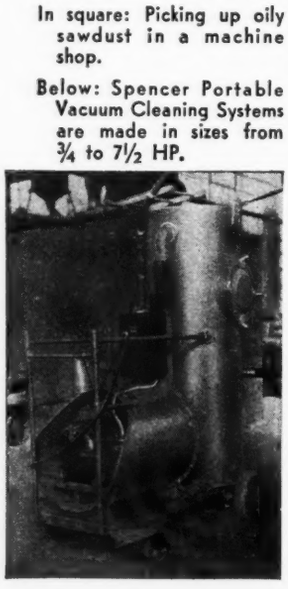
If your plant generates bulky litter, the new 7½ HP, 7½ cu. ft. dirt capacity portable will be of interest to you.

Ask for Bulletins No. 102C and 120F.

In circle: Cleaning above the cranes in foundry.

In square: Picking up oily sawdust in a machine shop.

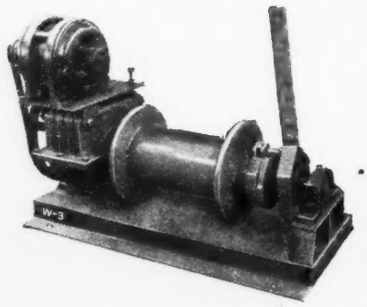
Below: Spencer Portable Vacuum Cleaning Systems are made in sizes from ¾ to 7½ HP.



SPENCER HARTFORD — CENTRAL AND PORTABLE VACUUM CLEANING SYSTEMS

THE SPENCER TURBINE COMPANY, HARTFORD, CONN.

182-C



without reversing same. Second feature is incorporation of SACO speed reducer in winch. This enables speed of drum to be determined by simply placing proper sized sheaves on motor drive shaft of speed reducer, since first and second reduction takes place through adjustable V-belts and cut-steel helical gears.

Stephens-Adamson Mfg Co, 5 Ridgeway Ave, Aurora, Ill.

Emergency Lighting Unit

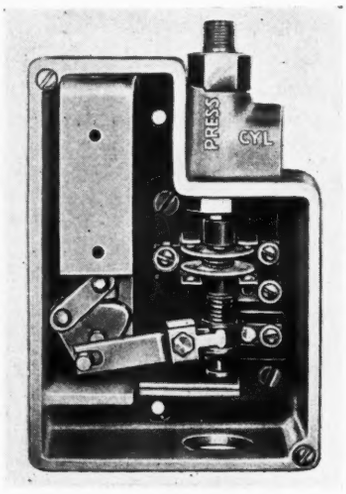
FEATURE of system is built-in 48-cell battery packed with dry material which does not become activated, or deteriorated, until lever releases activating fluid. Unit is connected to fluorescent tube light, which can be placed anywhere in room. There is also radium dial in center of system, and two individual emergency lights, which may be carried to other places.

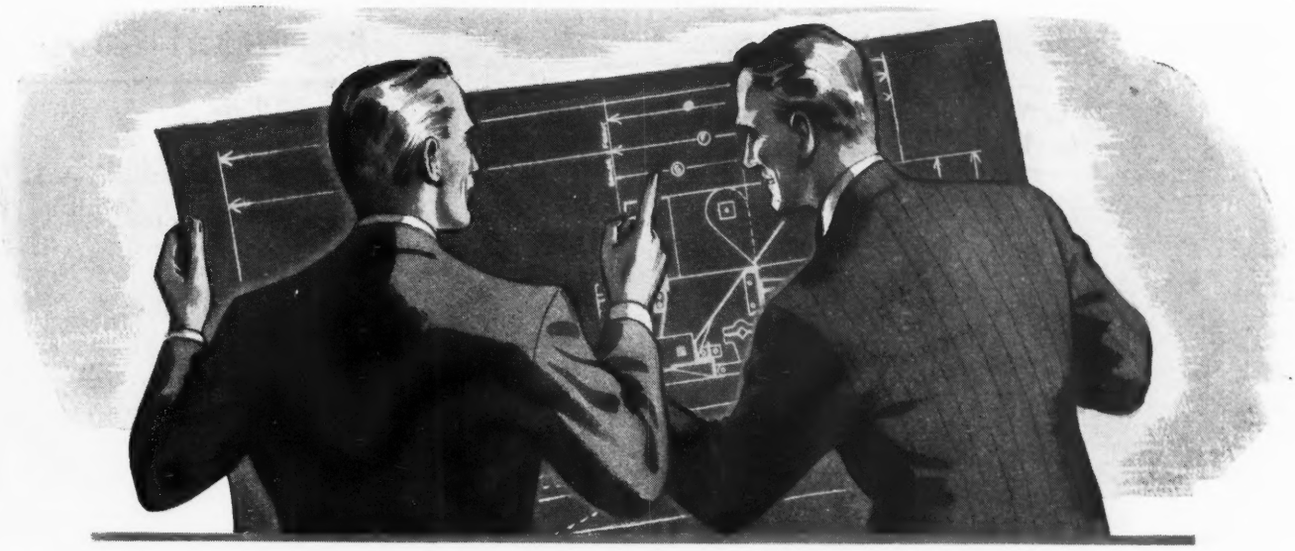
Triumph Explosives, Inc, Elkton, Md.

Solenoid Valve

THREE-WAY pilot-type valve, with momentarily energized single operating coil, is for air at pressures to 75 lb. Solenoid and simple operating mechanism is arranged so that energization of solenoid through 3-wire control circuit acts to close the open port and at the same time opens port which is closed, thus applying pressure to diaphragm or cylinder, or exhausting pressure from same, according to which of the control lines is closed or opened.

Automatic Switch Co, 41 East 11th St, New York, N. Y.





IT'S THE WHITING ENGINEER'S JOB TO KNOW THE *Correct* ANSWER

● There's only one *correct* answer to any heating problem. And that's the answer you'll get if a Whiting engineer checks your plant for you. For Whiting has had over 14 years of experience in the stoker business—makes a range of stokers to fit every type of commercial, industrial and institutional heating need.

WHITING EQUIPMENT HAS A CAPACITY RANGE FROM 15 TO 12,000 POUNDS AN HOUR

Not only are Whiting stokers accurately engineered for design and workmanship but they are *engineered to the special requirements of the individual job.* Starting with domestic models with a capacity of only 15 pounds of coal per hour, you'll find a complete range of stokers manufactured by Whiting. This range is up to 12,000 pounds per hour.

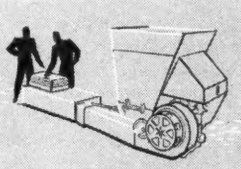
WHITING, A PIONEER IN STOKER DESIGN AND DEVELOPMENT

Whiting, during the past 14 years, has probably pioneered and developed as many significant mechanical stoker improvements as any other stoker manufacturer. To have a Whiting analysis of your problem is to be certain that it is solved in the most efficient, economical manner.

MAKE USE OF WHITING'S SERVICE

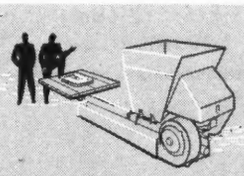
The service of Whiting combustion engineers is yours to use *without cost or obligation.* You'll find their recommendations sound—accurate—meeting the requirements of the job at hand in a manner that best solves the interest of the purchaser. Make use of the coupon below to secure this service and avoid the possibility of costly errors. Whiting engineers are always glad to work and cooperate with engineers and architects. Be sure to get a Whiting bid on every heating job.

THERE'S A FUEL-SAVING WHITING STOKER FOR EVERY HEATING NEED



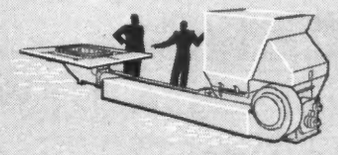
Whiting 100—150 lb. capacity

Available in both open and closed hopper models. (Automatic air control, illustrated, is available on all Whiting Commercial Stokers at slight extra cost.)



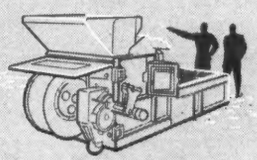
Whiting 200—250 lb. capacity

With Whiting's wide range of capacities there is a model designed to solve any heating problem economically.



Whiting 350—800 lb. capacity

Whiting makes a complete line of models so that every Whiting installation will be correct.



Whiting Horizontal—Compression Feed Stoker

Provides a uniform fuel bed, free from holes. Gives progressive combustion. Continuous ash removal. Assures you low-cost steam from low-priced coal.

WHITING CORPORATION

Manufacturers of Commercial Cranes and Material Handling Equipment and All Types of Special Machines.

Harvey, Illinois

WHITING CORPORATION, Dept. P 8, Harvey, Illinois
I'd like to have a Whiting survey of my heating equipment. I understand this will not obligate me in any way.

Name.....*Position*.....

Firm Name.....*Street*.....

City.....*State*.....

New ROTO Cleaners for the Latest Curved Tube Boilers

Boiler tubes are being curved more and more acutely every year. Roto engineers keep abreast of latest developments by keeping in constant touch with leading boiler manufacturers, and new cleaners are being designed to keep pace with changing requirements.

Whatever your cleaning problem may be, it will pay you to consult the Roto Company, tube cleaner specialists since 1910. Roto cleaners offer exclusive features found in no other cleaners. Write.

Rapid Action

ROTO

Cleans Tubes

★ **FASTER** — Rapid - action 'trigger' on motor eliminates signalling delays. Puts the boiler back on the line hours sooner.

★ **CHEAPER**—One-man operation eliminates helper and reduces cost of compressor operation.

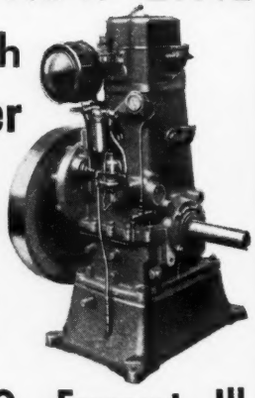
★ **BETTER** — Greater cleaning power of new design motor removes scale far more quickly and effectively.

See Our Adv. in Sweet's Catalog

The ROTO Company

145 SUSSEX AVENUE NEWARK, N. J.

STOVER *Announces* A NEW LINE of DIESEL ENGINES with Lanova Combustion Chamber



Smoother running. More power per cubic displacement and per pound, with proportionate lower cost. Available in 4 sizes and a variety of mounting bases. 7½ and 10 H.P. models are single cylinder. 15 and 20 H.P. are twin cylinder. Illustration shows conventional stationary type. Twin cylinder models have No. 1 Bell housing with enclosed flywheel. Write Dept. D83H for Bulletin No. 51 with complete information.

STOVER MFG. & ENGINE CO., Freeport, Ill.

Argument Corner

(Continued from page 108)

Corrosion alone is not responsible for grooving. This condition results from exposing areas of plate that are subjected to localized stresses to corrosive conditions.

Actually, the mud-ring, or any riveted seam, exerts a certain element of rigidity. If the plate adjacent to the rigid section is subjected to expansive and contractive forces, and is exposed to corrosive waters, grooving may result. The greater the expansion and contraction, the greater will be the localized stresses and the more rapid may be extension of grooving. This, I believe, is the reason why this condition developed noticeably after the oil-burner installation.

One photograph in the article shows two large oil burners per boiler, and due to the inherently limited furnace volume with this type of boiler, severe expansive stresses in the furnace sheets would not be unlikely, especially on starting up.

Forced circulation as later installed was a very good solution for the problem. But, forced circulation would not, and I dare say, did not prevent, or retard the corrosive element. It merely provided better thermal distribution and greatly relieved unequal expansion and resultant stresses —the 50% factor of grooving.

Canton, Mass. H M Spring

Engineers' Books

Air Conditioning

An Air-Conditioning Primer (1940). *By William Hull Stangle. Published by McGraw-Hill Book Co, 330 W 42nd St, New York, N. Y. 236 pages, 6x9 in., 210 illustrations, appendix containing 25 tables and psychrometric chart. Price $2.50.*

There have been many books on air conditioning, but this seems to be the first that has tried and succeeded in presenting the ABC's in a simple and understandable manner. Not for the technician, this book outlines the fundamentals for the benefit of those interested in the hundred-million-dollar air-conditioning industry, for the salesman, dealer, manufacturer, banker, and last but not least, the consumer.

Dividing the book into halves, one covering fundamentals and the other applications and apparatus, the author presents the story of air conditioning in a simply worded and cleverly illustrated style that makes even abstruse psychrometric principles clear and easy to understand. For an example of the simplicity of presentation take the division of air-conditioning fundamentals into four parts under these chapter headings: "Heat—Nature Takes a Hand", "Air: An Ocean—We Live in It", "People: You and I—What Makes Us Tick', and "Enclosures: All Wrapped Up in Cellophane". Every effort has been

PROVED TO SAVE!

How Lubriplate Lubricants are cutting costs, saving time and labor in plants everywhere

The superintendent of a large Birmingham, Ala. concern* manufacturing heavy duty machinery writes, "In July we tried Lubriplate 130-A on the worm and wheel indexing mechanism of a 24" gear cutting machine. There was such a remarkable reduction in the friction we have been using Lubriplate on all gearing and heavy bearings and are now recommending it to our purchasers of large gears and other machinery."

In the plant of a prominent manufacturer* of asbestos products located in Bridgeport, Conn., it was necessary to repair or entirely replace the joints in a 600 ton toggle press every four to six months. This concern writes, "The use of Lubriplate No. 305 on these heavy duty toggle joints began over a year and a half ago and it looks as if they will run indefinitely."

World's largest construction job—Grand Coulee Dam. An unsolicited report states, "Lubriplate certainly solved the heat and dirt situation besides saving 75 pounds of grease per machine per week. Where we had used four kinds of grease, we used but two Lubriplate products—Nos. 110 and 130-A. Bearings cooled down and wear reduced to ⅓ of what we had become accustomed to expect."

* Name on request.

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Lubriplate meets today's heavy duty service requirements because it is different from ordinary lubricants. It "stays put" and lasts *longer*. What's more, Lubriplate is extra resistant to rust and corrosion. Write—we'll see that you receive enough Lubriplate for a thorough test.

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NOZZLES

Unique Yarway Involute design.

No internal parts or vanes to clog or erode.

Unobstructed flow gives minimum loss of head.

Finely divided spray cone provides rapid cooling.

Renewable orifices adapt nozzles for any service.

Installations total more than 5 million gallons per minute in water cooling and air conditioning service.

Made in both cast and bar-stock types. All sizes from 1/4 in. to 2 1/2 in. Write for Catalog N-615.

YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia

made to keep the presentation free from technicality but technical accuracy has been preserved and most recent developments have been included. The appendix contains tables of heat-loss factors.

Legal Aspects

LEGAL ASPECTS OF ENGINEERING (1940). *By Walter C Sadler. Published by John Wiley & Sons, Inc, 440 Fourth Avenue, New York, N. Y. 631 pages, 6x9 in., cloth binding. Price $4.00.*

Engineers all too often become acquainted with the law after being tangled up in some litigation. This book gives the engineer a knowledge of the special legal features of his profession and the problems he may encounter in its practice and, by so doing, aims at warning him in advance of situations which may involve himself, his employer, or his client in unsuccessful litigation.

Instead of developing abstract principles which the engineer must absorb and memorize, this book follows the "case method" widely used in legal training. The various legal principles affecting different types of engineering work are developed by study of actual cases illustrating these points. To cover the field, the author selected some 300 cases from more than 6500 actually dealing with engineering problems. The cases are carefully classified and grouped under these headings: Professional Problems, Industrial Problems, Aeronautics, Property, and Business. Reading these cases proves interesting and seems to bear out the author's contention that the case method is more stimulating mentally than the "textbook" method. This book should be particularly valuable to consulting engineers and to engineers employed in an executive capacity.

Gas & Oil Power

GAS AND OIL ENGINES (1939). *By Peter S Caldwell. Published by Chemical Publishing Co, Inc, 148 Lafayette St, New York, N. Y. 125 pages, 4 1/2x7 1/2 in., illustrated, cloth binding. Price $1.50.*

In this small handbook, the author has compressed the fundamental principles of operation, general features of construction, and methods of operation and test of gas and oil engines. Reference throughout is to small engines, and the oil engines are of the "semi-diesel" type.

The fact that data and illustrations are from English practice limits the book's usefulness to American engineers and operators, but much of the material on principles and methods of operation applies equally well in this country. The style is simple and straightforward, with emphasis on practical considerations rather than theory.

STANDARDS OF HEAT-EXCHANGE INSTITUTE (1940). *Published by Deaerator and Deaerating Heater Section, Heat Exchange Institute, 90 West St, New York, N. Y. 12 pages, paper bound. Price $.75.*—Contains recommendations on nomenclature, definitions, constructions, ratings, accessories and typical applications of deaerators.

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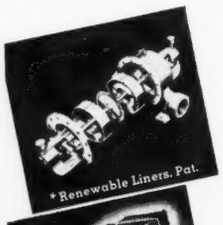
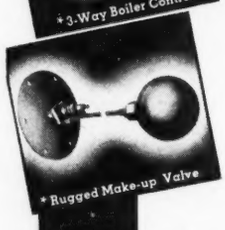
BOILER FEED SYSTEMS

Backed by over twenty years experience in producing high-efficiency condensate return equipment, Westco Automatic Boiler Feed Systems give you EXTRA advantages that cut fuel costs . . . save labor . . . increase plant efficiency. Check the following features and you'll know why Westco leads the field.





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1. Automatically returns condensate to boiler.
2. Make-up water automatically added as needed.
3. Maintains uniform water level in boiler.
4. Always on duty . . . keeps return lines open.
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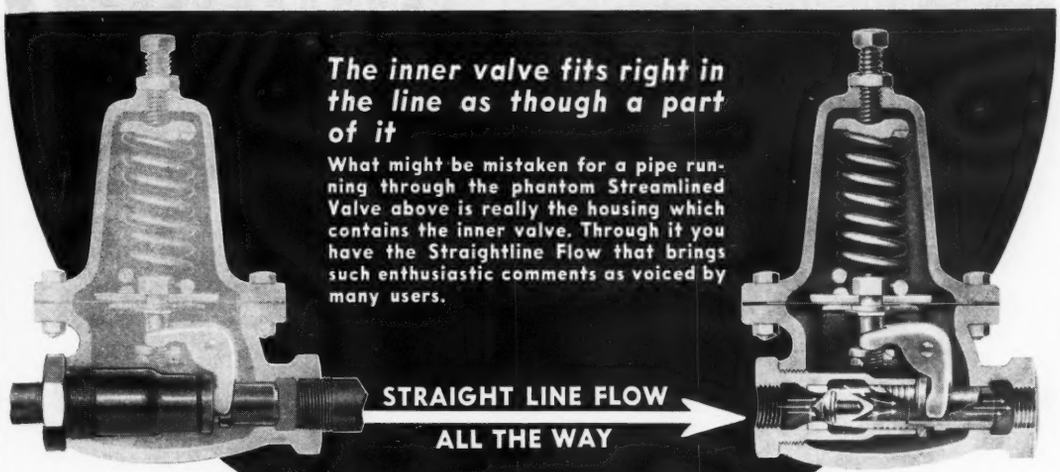
"We are glad to tell you that your Streamlined 1000-LP Valve has enabled us to speed up operation on our Hosiery Setting Machine about 20 to 25%. This is because your Valve gives such rapid action in bringing up the pressure and in holding the pressure constant during the preboarding operation."



The inner valve fits right in the line as though a part of it

What might be mistaken for a pipe running through the phantom Streamlined Valve above is really the housing which contains the inner valve. Through it you have the Straightline Flow that brings such enthusiastic comments as voiced by many users.

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVE

A valuable tool to help you speed operations, cut maintenance, save money

***Free* TRIAL** Prove for yourself what others say about CASH STANDARD Streamlined Valves—do it at no cost—tell us to ship one to you on 30 days' free trial—after 30 days you get a bill—you either pay for it then or return valve to us at our expense—order one on trial today—see why there are no failures—decreased attention costs—no heat or chemical troubles.

BULLETIN 1000 TELLS COMPLETE STORY

You may select a CASH STANDARD Streamlined Valve exactly suited for your service conditions. Bulletin 1000 shows how. Any combination of metals can be obtained for body, trim, valve seat, and seat ring. Handwheels for quick pressure adjustment also available.

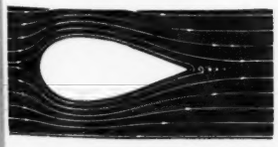
IMPORTANT CHARTS SHOWN IN BULLETIN 1000

Steam, air, water capacity charts for all Streamlined Type 1000 Valves are shown in Bulletin 1000. These charts are easy to use—they enable you to determine precisely how much fluid any size Streamlined Valve will deliver under your exact pressure conditions—for steam, air (and other gases), water (and other liquids).

VALVE TURBULENCE ELIMINATED

The valve increases performance results by eliminating the ordinary valve turbulence indicated in illustration above. There is no detour around a dividing wall — the direction of flow is not changed at right angles because of a seat wall—also, the flow is not broken up by valve stems, springs, or other parts.

REDUCED PRESSURE NEVER VARIES



You get Streamlined flow as indicated in illustration above. Because of this Streamlined flow and no turbulence, you are easily able to meet peak demand and yet hold the reduced pressure constant at the same time. You experience no spoilage results due to erratic pressure — because the reduced pressure never varies.

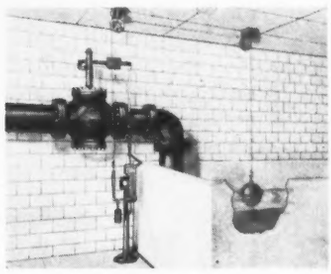
CASH STANDARD CONTROLS . . VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

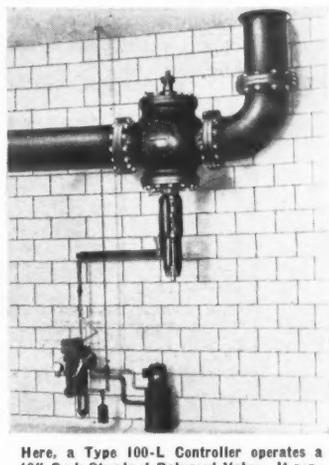
A CASH STANDARD "GET ACQUAINTED" COLUMN

Question: **"Don't you people make anything besides that Streamlined Valve you talk about so much?"**

Answer: **"Yes Sir; we do! And we propose to picture one or two of them here each time."**



In automatic liquid level control, two things are often of prime importance: (1) to hold the level within the closest kind of limits; (2) to do it dependably, day by day. How Cash Standard controls do both is shown above. A Type 100-L Controller operates a 12" Balanced Valve regulating liquid supply to a large tank. It is pilot actuated for sensitivity. It has operating power to spare —for any size Valve, however large.



Here, a Type 100-L Controller operates a 10" Cash Standard Balanced Valve. It regulates flow through a make-up line to a "dirty water" heater on the floor above. The lever of the "100-L" responds to slightest movement of a float in the heater—causing immediate movement of the power piston which operates the Valve. But there is no "hunting" because the Controller is fully compensated. It has a "range" adjustment too. It gets accurate results with any size valve—no matter how small or how large the valve may be. It is simply a matter of using the right size power cylinder.

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at threaded or flanged joints

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Smooth-On maintains tightness against steam, water, gases, oils and many chemicals, regardless of vibration or extreme pressure and temperature changes. On screw threads, Smooth-On also acts as a lubricant for easy assembly and permits the joint to be taken apart.

Buy Smooth-On in 7-oz., 1-lb., 5-lb. cans or 25-lb., 100-lb. kegs from your supply house or if necessary, from us. For your protection, insist on Smooth-On—used by engineers since 1895.

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Do it with
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Power Lines

(Continued from page 128)

equipped with Elesco superheaters and economizers, Ljungstrom air preheaters, and each will be served by three C-E Raymond bowl mills. Furnaces will be of the continuous slag-drip type, tangentially fired. Installation is scheduled for completion in 1941. Station will then have total installed capacity of 300,000 kw in high- and low-pressure units.

Forced-Circulation Boiler for Somerset Station

This country's first large forced-circulation boiler, which may mark the beginning of a new epoch in high-pressure steam generation in the U. S., has been ordered from Combustion Engineering Corp. It will go into the Somerset Station of the Montaup Electric Co for which Stone & Webster Engineering Corp is acting as consulting engineers.

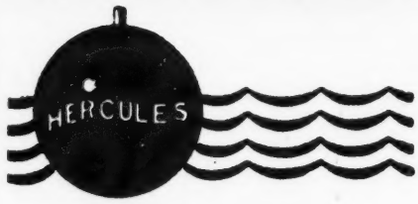
The unit is designed for an output of 650,000 lb of steam per hour at 2000 lb pressure and 960 F total steam temperature. It will serve a 25,000-kw topping turbine-generator exhausting to the existing 375-lb station mains which supply two low-pressure turbine units having a combined capacity of 76,000 kw. Steam for the latter is now furnished by five low-pressure boilers, each of which occupies a floor space equivalent to that required for the new high-pressure boiler. After exhausting from the topping turbine at around 400 lb, the steam is returned to the high-pressure boiler for reheating to 750 F before passing to the low-pressure turbines. It is anticipated that the topping installation will reduce the station heat rate from over 14,000 Btu per kwhr to between 10,000 and 11,000 Btu.

The new unit will be tangentially fired for burning either pulverized coal from the existing storage system or for burning oil as an alternate fuel. Included in the unit are a convection-type superheater, reheater, economizers and regenerative air preheaters. The superheater is laid out for a practically constant steam temperature from full load down to 480,000 lb per hr.

There will be three circulating pumps, one motor-driven, one turbine-driven, and one with dual drive, any two of which will provide circulation for all load conditions. The feed pumps take feedwater at 475 lb suction pressure and deliver at 2200 lb.

In natural-circulation boilers, circulation is dependent upon the varying densities of the water and water-steam mixtures at different temperatures. For high steam pressures this involves placing the drums at considerable height in order to provide the necessary hydraulic head to assure circulation. On the other hand, the forced-circulation design insures positive circulation, independent of the load, allows flexibility and compactness in the arrangement of the heating surfaces, and permits the steam drum to be placed in any convenient location.

HERCULES
Seamless Copper
FLOATS



GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process, Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

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200 Franklin St.
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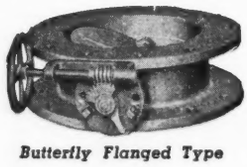
Save Air—Save Dollars
With
ROCKWELL
BLAST GATES
For Low Pressure Air



Butterfly Flanged Type

Slide Type
Butterfly Type
Wafer Butterfly Type
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HEATS THE PLANT — **POWERS THE PLANT**

. . . that builds this popular new HUDSON SIX!

● The Hudson organization constantly strives, in *engineering*, *purchasing*, and in *manufacturing* . . . to develop production efficiency for their high quality car. That's why Hudson engineers specify *economical COAL* as the *efficient*, *dependable* fuel for the Hudson Motor Car Company, factory at Detroit.

Do you have a fuel problem? Check on it with Chesapeake and Ohio's trained Fuel Service Engineers . . . they'll gladly help you make comparative cost and efficiency studies . . . without charge.

Chesapeake and Ohio can give you exactly what you need in coal, for in the mines of the region served by the railroad—"The Coal Bin of America"—you can get coal prepared and sized to *your* order . . . coal of the quality that means dependable operation.

Delivery service is *quality* too . . . Chesapeake and Ohio's A-1 equipment and personnel are combined to bring coal buyers exactly what they want . . . *carefully*, *speedily* and *on time*.

For information or assistance with fuel problems, write GEORGE H. REINBRECHT, Coal Traffic Manager, Chesapeake and Ohio Lines, 2901 Terminal Tower, Cleveland, O.

CHESAPEAKE AND OHIO LINES

Another OAKITE IDEA to help you save!

LOW-COST WAY TO CLEAN CONDENSERS

Cleaning surface condensers is NOT a tough, lengthy job for many plant engineers who use the successful Oakite method. No dismantling of equipment needed. Just circulate through water or steam side, or allow to soak as directed, a solution of recommended Oakite material. Scale or other deposits are thoroughly removed. Better vacuum is secured.

Method is surprisingly easy, economical. You do the job FASTER, at lower cost, than is possible with mechanical methods. In one plant, for example, it took a half day's work to clean 10 tubes mechanically; it took 20 hours to clean 500 tubes the Oakite way!

Save Money...Save Time ON THESE JOBS, TOO!

In such other work as stripping transformers, cleaning air filters, steam cleaning and washing walls and floors, Oakite materials can save money, save time for you! Ask for specific, helpful data on your cleaning problems. Write today. No obligation.

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23 Thames Street, New York, N. Y.
Representatives in All Principal Cities of the United States and Canada.

OAKITE Certified cleaning
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

Beauharnois Plant Gets More Water for Power

The Canadian Parliament has authorized as a war measure an increase in the diversion of water from the St. Lawrence River for the development of power in the Beauharnois plant above Montreal, it has been announced. This will permit the output of the plant to be increased from about 420,000 hp to 680,000 hp, the increase to go to Ontario for use in war industries.

This plant is a private power project in Quebec designed ultimately to develop 2,000,000 hp at the lower end of a canal around the rapids in the Soulanges section of the St. Lawrence River. First units in the plant were put in service in 1932 and additions have been made since that time.

Power Show to Be Largest Since 1930

The 14th National Exposition of Power and Mechanical Engineering will be the largest since 1930, if advance reports from the headquarters are any indication. More than six months before the show opens, nearly 250 leading concerns have engaged exhibit space: The show will be held in Grand Palace, New York, N. Y. from December 2 to 7, 1940. Attendance is limited by personal registration and is confined to those executives, engineers and operating men interested in equipment for the generation, distribution and utilization of power.

Fire Sweeps Erie Electric Co Building in Buffalo

The building housing the Erie Electric Motor Repair Co at 124 Church St, Buffalo, N. Y. was swept by fire in May, causing approximately $4000 damage to the building, and $40,000 to the motors, fans, etc, in the building. The fire caused by sparks, coming from heating apparatus on the street, being drawn by a ventilating fan through second floor windows and igniting solvent used to clean motors coming in for repair. Two years ago the building was damaged by a blaze caused by an oil-burner explosion.

ASME Nominees listed

The nominations for 1941 officers of the American Society of Mechanical Engineers were announced recently. Prof O A Leutweiler, chairman of the nominating committee, made the announcement. The election will be held by letter ballot of the entire membership closing Sept 24. The nominees as presented by the committee are:

President: William A Hanley, In Charge of Engineering, Eli Lilly & Co, Indianapolis, Ind.

Vice-presidents: Dean Samuel B Earle, School of Engineering, Clemson Agricultural College, Clemson, S. C.; Frank H Prouty, Prouty Bros Engineering Co, Denver, Colo.; Edwin B Ricketts, Mechanical Engineer, Consolidated Edison Co of N. Y.

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Adjustable
SPROCKET RIM
with Chain Guide
MAKE YOUR OVERHEAD VALVES SAFE and EASY TO REACH—
CONTROL VALVES FROM THE FLOOR
With Babbitt Sprocket Rims on your overhead valves, you can control valves instantly from the floor. Far quicker and safer than climbing ladders.
Babbitt Rims are easily attached in a few minutes, are inexpensive and assure safe, positive and instantaneous overhead valve operation. Available for valves of every make or style. Write for details.
BABBITT STEAM SPECIALTY CO.
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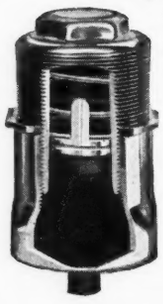
TRY *at our expense*
WRITE ON YOUR BUSINESS LETTERHEAD, FOR FREE SAMPLE OF
HUNTER

"Airspring" Grease Cups



Drawn - steel, cadmium plated . . . *Never known to rust!* Standard in whole industries!

"Shurflo" Oil Cups

Designed for service where grit, dust or lint is a problem. A superior cup in every way. Test it; prove it!

HUNTER SPRINGS - STAMPINGS
HUNTER PRESSED STEEL CO.
Lansdale, Pa.

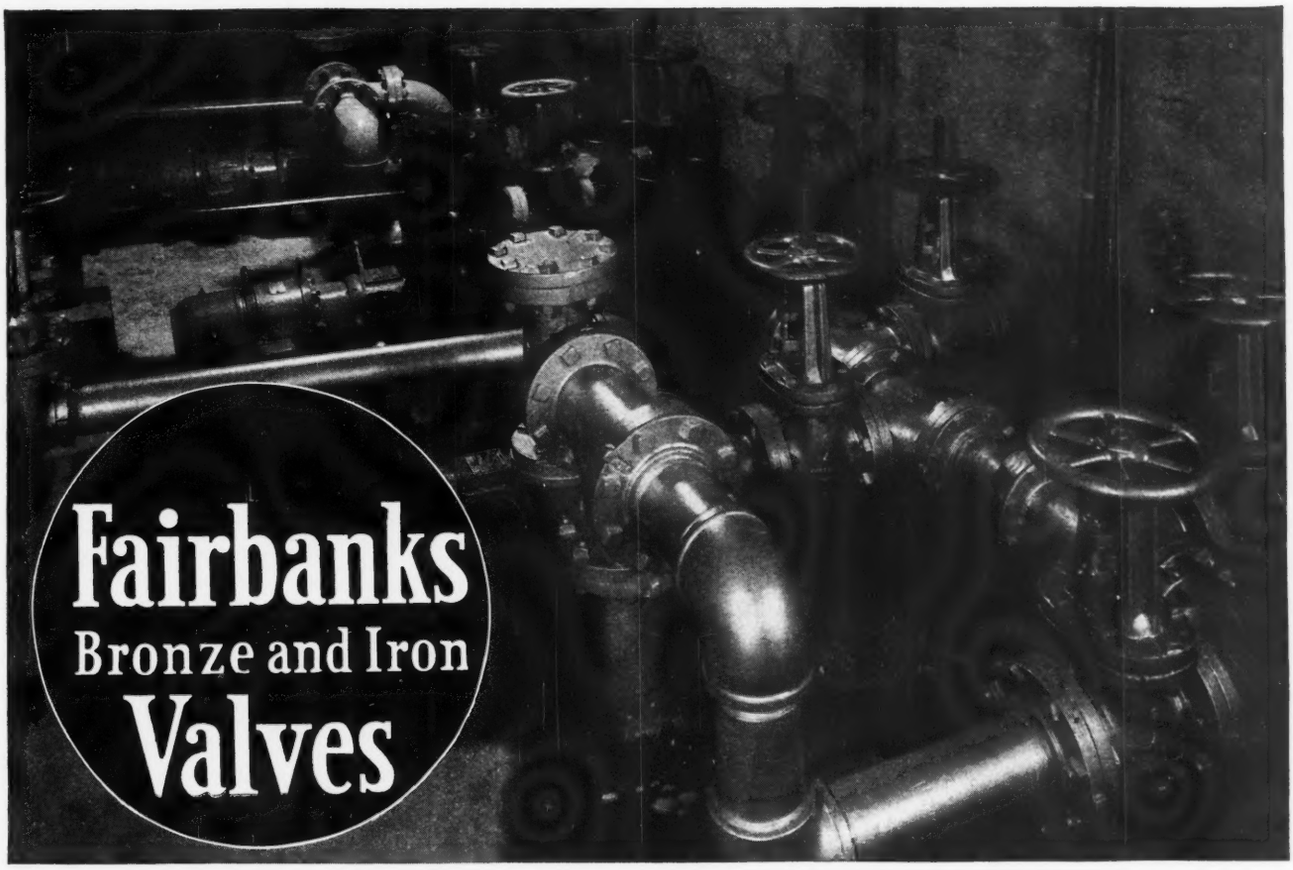


Illustration shows another typical installation of Fairbanks Iron-Body Valves that have been in use for many years and are still giving good service. The extensive use of Fairbanks Valves in prominent industrial plants throughout the country is conclusive proof that they operate easily, shut tightly, repack easily, renew quickly and are low in maintenance cost.

To guard against failure at points where our long experience has taught us that failure is most likely to occur, we make Fairbanks Iron Valves of special semi-steel, which has 66-2/3 more tensile strength than ordinary cast iron, and distribute the metal to give the greatest strength where needed. Threads are accurately cut. All parts are machined to exacting standards of precision. And after assembly every valve is subjected to the most severe test.

Fairbanks Valves are made in bronze and iron for a large range of pressures, in globe, gate, angle, check and cross patterns.

Ask your distributor's salesman to disassemble a Fairbanks Valve and explain the superior construction of each part. You'll probably say you've been overlooking a good thing.

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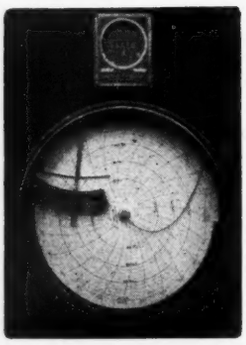

The selection of SIMPLEX meters for your flow measuring problems insures ECONOMIES resulting from low first cost and minimum maintenance and operating charges.

The ability of the SIMPLEX meter to measure with extreme ACCURACY over wide flow ranges insures the obtaining of a definite knowledge of all flow conditions.

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There is a SIMPLEX instrument FOR YOUR specific problems.

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Managers: Prof Huber O Croft, Head of Mechanical Engineering Dept, State University of Iowa, Iowa City, Iowa; Prof Paul B Eaton, Charge of Mechanical Engineering Dept, Lafayette College, Easton, Pa.; George E Hulse, Chief Engineer, Safety Car Heating & Lighting Co, New Haven, Conn.

Inland Empire Section Host to ASME Meeting

The Inland Empire Section, ASME, will be host to the Fall Meeting of the society, to be held at Spokane, Wash., Sept. 3-6. Arrangements for the program have been made, and include technical papers to be presented in meetings sponsored by the society's Hydraulic, Wood Industries, Fuel, Power, and Management divisions. Program calls for technical sessions on Tuesday, Sept. 3, and Thursday, Sept. 5, leaving Wednesday and Friday open for inspection trips.

A trip to Grand Coulee Dam on Wednesday will be preceded by a general talk on the Dam at a banquet Tuesday. Headquarters for the meeting will be the Davenport Hotel in Spokane.

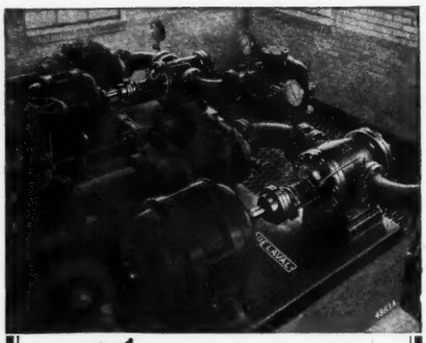
OBITUARIES

Louis E Murphy, 66, formerly president and chairman of the board of E F Houghton & Co., died June 26 at his summer home at Mantoloking, N. J., following a short illness. He had been connected with the Houghton organization for 52 years, having started as an errand boy in 1888. He was elected secretary of the company in 1910, vice-president in 1914, and president at the time of Charles E Carpenter's death in 1929. He became chairman of the board in 1934, when A E Carpenter was made president. After his resignation in 1936 he continued as a director up until the time of his death. From 1931 until his retirement he was editor of the Houghton house organ, "The Houghton Line".

John B Garden, 80, president of the Wheeling Electric Co, Wheeling, W. Va., and pioneer in the development of the power industry, died suddenly July 7 at his home in Wheeling. He guided the business he established at Wheeling from a small concern of 40-lamp service to one serving many communities.

William S Ralston, 70, president of the Chaplin-Fulton Mfg Co, Pittsburgh, Pa., died on July 3. He attended Rensselaer Polytechnic Institute, and also studied at Columbia University in New York. Mr Ralston had been connected with the Chaplin-Fulton Mfg Co for nearly 40 years. He was the inventor of several pressure regulators and regulator improvements, and was a member of the American Gas Association.

Everton Chapin Knapp, 71, steam engineer in Buffalo, N. Y. for 30 years, and past president of the Keystone Lodge No. 16, National Association of Power Engineers, died June 10, after an illness of several months. Before his retirement last



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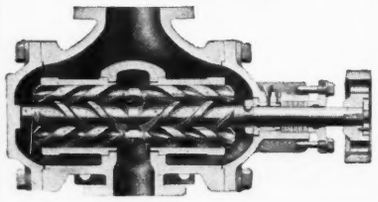
IMO
for fuel oil

These De Laval-IMO pumps transfer 100 g. p. m. each of Bunker C against 100 lbs. pressure. Other IMO's in the same plant deliver the oil to the burners at 300 lbs. All are coupled directly to the driving motors. There are no gears, and no valves, and the delivery is uniform, as from a continuously moving piston.

Ask for Catalog 1-62

DE LAVAL STEAM TURBINE CO.
Trenton, New Jersey



PACKING—
with the Character of
SOLID SILVER

PALMETTO Packing is the same at the core as on the surface. The quality goes all the way through. Lubricated long fibre asbestos provides long life and low friction. PALMETTO Packing will not deteriorate from time or weather conditions. It is always completely and uniformly lubricated . . . ready for use. PALMETTO is made *Braided Square* for rods *Twisted* for valve stems.

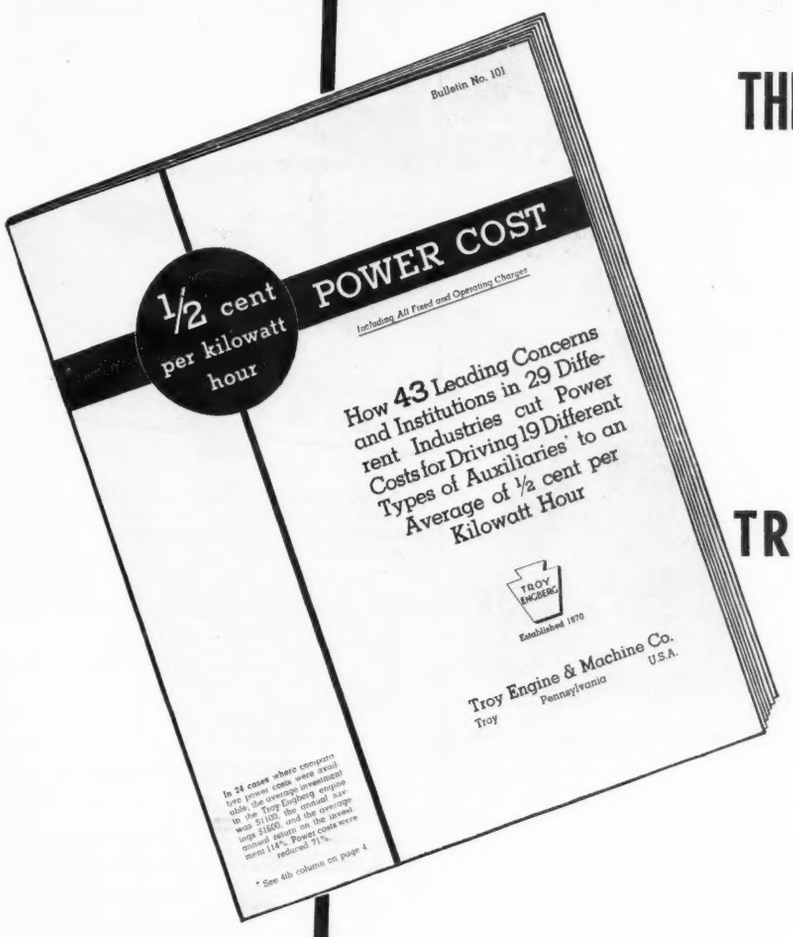
*PALMETTO for Steam • *PALCO for Water
*PELRO for Solvents • *CUTNO for Alkalis
*SUPER CUTNO for Acids

*Reg. U.S. Pat. Off.

GREENE, TWEED & CO.
SELF-LUBRICATING & SHEET PACKINGS
101 Park Ave., New York, N. Y.
Established 1863

PALMETTO
Reg. U. S. Pat. Off.
PACKING

A Summary of Worthwhile Power Savings!


Bulletin No. 101
1/2 cent per kilowatt hour
POWER COST
Including All Fixed and Operating Charges
How 43 Leading Concerns and Institutions in 29 Different Industries cut Power Costs for Driving 19 Different Types of Auxiliaries to an Average of ½ cent per Kilowatt Hour
TROY ENGBERG
Established 1870
Troy Engine & Machine Co.
Troy Pennsylvania U.S.A.

THIS BULLETIN TELLS HOW

23

Companies Invested

$25,330

IN

TROY-ENGBERG STEAM ENGINES

and are now saving

$37,300

EVERY YEAR IN POWER COSTS

It also tells how 20 other companies reduced power costs to an average of only 0.67 cents per kw.h.

What power man isn't interested in power cost savings no matter where made or how? We take it that you are no exception so why not send for this Bulletin?

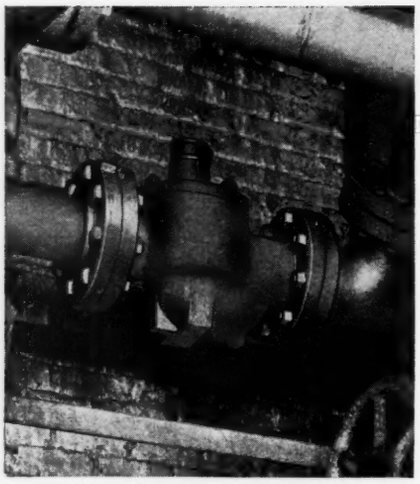
In it are true, bona fide power cost savings computed from data provided by the users' own engineers. The Troy Engines involved are driving 19 different kinds of auxiliary equipment such as stokers, pumps, compressors, fans, generators, etc.

Every plant that can use steam for heating or processing during the greater part of the year is *probably* in position to save considerably in power costs if it uses a steam engine instead of any other type of drive. If your plant is in this class, why not investigate fully the merits of the modern steam engine?

TROY ENGINE & MACHINE CO.

Established 1870

1464 Railroad Ave., Troy, Pa.



HENSZEY METERS

like the one above are giving satisfactory service to these and many other users.

	Installations
Evaporated Milk Co.	68
Evaporated Milk Co.	25
Evaporated Milk Co.	8
Evaporated Milk Co.	7
Evaporated Milk Co.	5
Can Manufacturer	38
Silverware Mfr.	7
Chain Store	11
Eastern University	8
Large Municipality	5
Hotel Chain	5
Two Steel Mfrs.	5 ea.
Three Power Companies	5 ea.
Distillery	6
Paper & Chem. Mfg. Co.	8
Paper & Chem. Mfg. Co.	5
Paper Mfg. Company	6
Govt. Housing Project	6
Tobacco Co.	5

•

When you want a meter for a difficult job . . .

Look for these Henszey Meter features!

- Goes right in the line.
- Accurately measures flow of reciprocating pump.
- Operation not dependent upon close clearances.
- Can be calibrated in gallons, pounds, or cubic feet at any specified temperature.
- Sizes from 10 g.p.m. to 1,000 g.p.m. cold water rating, connections ¾" to 6".

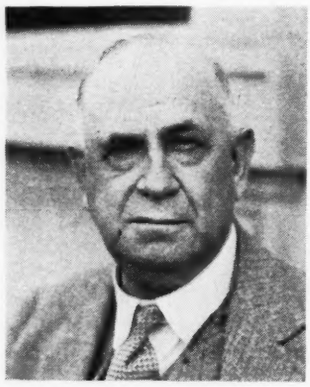
Check your meter equipment today—then send for complete information about the Henszey Meter.

HENSZEY COMPANY

Dept. D8 **Watertown, Wis.**

year, he had worked as chief engineer in many of the largest buildings in the city.

RAYMOND F WALTER, 67, chief engineer of the U. S. Bureau of Reclamation since 1925, died in Fresno, Calif on June 30. He graduated from Colorado Agricultural College as a civil engineer and soon joined the staff of E E Baker, where he practiced in irrigation work. In 1908, after a previous career in irrigation projects, he was made supervising engineer of the Rocky Mountain Div of the U. S. Reclamation service, which position he held until 1915, when he became senior engineer of the Bureau of Reclamation. In 1917 he was



Raymond F Walter

made assistant chief of construction of the Bureau; in 1920 he became assistant chief engineer, and four years later he succeeded F E Weymouth as Chief engineer. During his long service in this position he directed the planning and construction of all the great works for which recent Reclamation construction is notable, including Boulder Dam, All-American Canal, Grand Coulee and the Central Valley Projects.

PERSONALS

G B FLANIGAN has been appointed New York district manager of Chain Belt Co, succeeding W H Quinn, who died recently. Mr Flanigan entered the employ of the company immediately following his graduation from Sheffield Scientific School of Yale University in 1925.

JOSEPH C TRYON, chief engineer, Sisters' Hospital, Buffalo, N. Y., was elected president of Keystone Chapter, No. 16, National Association of Power Engineers on June 27. Other new officers are Fred Diebold, F N Burt Co, vice-president; Frank Savage, Riverside High School, corresponding secretary; James Habish, recording secretary; William Bucks, Fedders Mfg Co, financial secretary; George Diebold, F N Burt Co, treasurer; John O'Neill, conductor; and Frank Daka, Dunlop Tire & Rubber Co, doorkeeper. President Tryon, George Diebold, George Grupp, Leonard Thiel, Thompson and Bartley McCourt were elected delegates to the national convention in Columbus, Ohio.

J L JURGES, former mechanical goods salesman for Goodyear Tire & Rubber Co

HENSZEY
BOILER FEED REGULATORS

Easier steaming, higher loads and longer boiler life result when you install Henszey Boiler Feed Regulators to accurately and dependably control boiler water levels.

These simple, compact, self-contained units go right in the feed line and require no additional structural support. They are as easy to install as a simple gate or globe valve. Once installed and set for operation no further attention is necessary — nothing to get out of order — nothing to reset.

Send for latest Bulletin containing full details.

HENSZEY COMPANY

Dept. D8—Watertown, Wis.

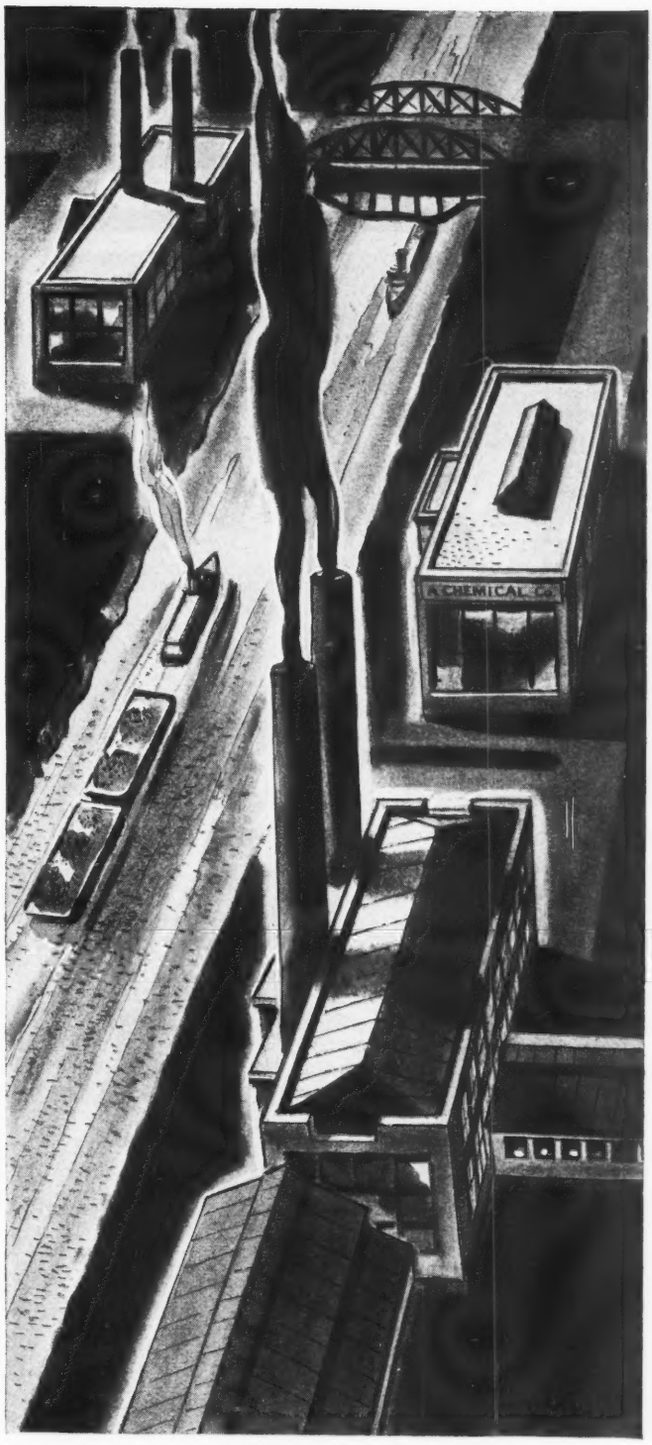
YOUR
Dependable Guide

. . . to the big things and little things done each month by operators and manufacturers across the country to raise plant efficiencies, cut costs, and reduce trouble.

It Pays You to

Read POWER Regularly

NEIGHBORING PLANTS *CAN'T RECOMMEND THE CORRECT CONDENSER TUBE ALLOY*



...BUT A BRIDGEPORT ENGINEER CAN

Even though your plant's operating requirements are similar to your neighbor's, there are so many factors involved in condenser tube service that you may need an alloy entirely different from the one he uses. For example, a slight change in operating pressures or the gas content of your water, as compared to his, could radically affect your tube life.

Such small but important variables are reasons why so many plants consult with a Bridgeport Condenser Engineer before they retube. His experience has come through field work on power, refinery, and marine installations of nearly every conceivable variety—and, by actual first-hand studies, he knows how tubes perform *in operation*. His knowledge of the results of *varying* conditions on tube life can be valuable to you.

Before you order—let him apply this wide experience to the solution of your tube problem. He may be able to suggest a new alloy that will materially reduce your maintenance costs through longer life. Or he may recommend a less expensive alloy with the same service life as the one you are now using.

For new or retubing jobs on condensers or heat exchangers — and for all other tube problems — a consultation with Bridgeport will be profitable for you.

"Bridgeport" BRASS CO.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY • BRIDGEPORT, CONN. • ESTABLISHED 1865

WRITE FOR YOUR COPY

BRIDGEPORT BRASS COMPANY,
Condenser Tube Engineering Dept. C
Bridgeport, Conn.

☐ I'd like to have a copy of the new revised "Condenser Tube Manual."

☐ I'd like to talk to one of your condenser engineers about my problem.

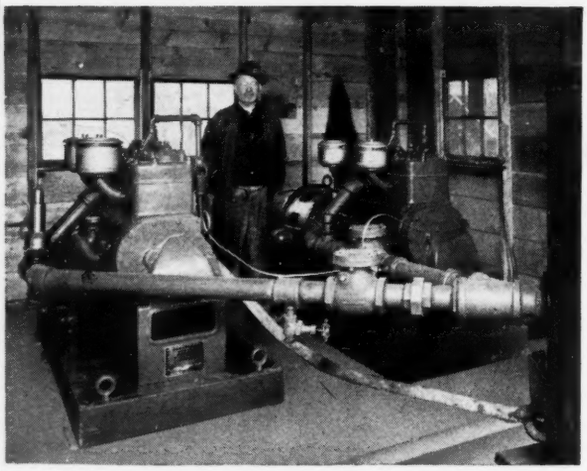
NAME.....

COMPANY..... TITLE.....

ADDRESS.....

CITY..... STATE.....

SCHRAMM
AIR COMPRESSORS



1050 CFM of Air Compressors with Direct Motor Drive.
1—600 CFM with 100 HP Motor.
1—450 CFM with 75 HP Motor.
Total Floor Space About 8½ Ft Square

COMPACT DESIGN

VIBRATIONLESS NO FOUNDATION

FULL PRESSURE LUBRICATION

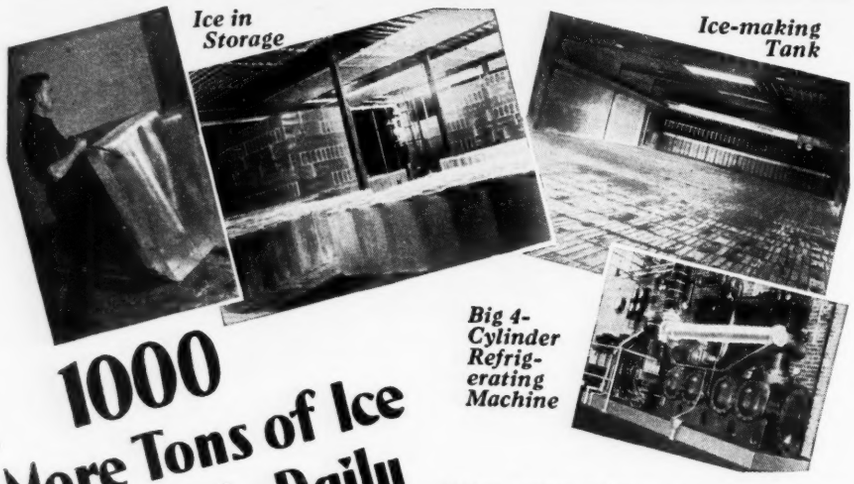
AUTOMATIC PRESSURE CONTROL

OTHER SIZES 25 to 600 cfm

SEND FOR BULLETIN 3907

ESTABLISHED, 1900 — 758 E. VIRGINIA AVE.

SCHRAMM, INC., WEST CHESTER, PA.



1000 More Tons of Ice now made Daily in New York area with FRICK

What better evidence could you want that the ice industry is going places Seven thousand 300-pound blocks a day is a lot of ice! But four recently built plants, each with up-to-the-minute Frick refrigerating and ice-making equipment, are producing it with ease. One plant harvests 37 blocks at one lift.

Refrigerating systems have been improved as much in recent years as automobiles! Is your business getting the benefit of these better methods of cooling? Let the nearest Frick Branch or Distributor assist you in making the savings now possible (up to 34 per cent!) over former methods. Write

FRICK COMPANY, Waynesboro, Penna.

Ice-making Equipment

at Jacksonville, Fla., has been appointed district manager. He replaces E A Filley, who resigned to become general manager of Manufacturers Rubber Supply Co.

R T Steindorf has been appointed district manager of the Chicago office, Chain Belt Co, of Milwaukee, Wis. Following graduation from Purdue University in 1924 he joined the company as apprentice. Since that time he has worked in both the sales and engineering departments of the company.

Walter Josephson, Jr., son of the late Walter S Josephson who was the discoverer of "Dry-Ice" and founder of that industry, has become associated as a sales engineer with Greene, Tweed & Co, New York.

Louis B Morse, Jr, of the York Ice Machinery Corp, has been elected chairman of the Detroit chapter, American Society of Refrigerating Engineers. John A Schurman, also of York, has been made vice-president of northern Ohio chapter of the American Society of Heating & Ventilating Engineers. He was also made chairman of the Cleveland Engineering Society's Building Code Committee.

J E Despins, Mining Div, Allis-Chalmers Mfg Co, Milwaukee, Wis., has recently been transferred to the company's El Paso district. He is a graduate of Michigan College of Mining and Technology and completed the company graduate student course prior to his service with the mining division.

George R Davison, for the past 35 years a member of the Boston Edison Co's staff and long connected with the production department as an engineer, has retired from active service. Mr Davison was presented with a watch by associates in the company at a recent dinner in Boston, tendered him in appreciation of his work in the field.

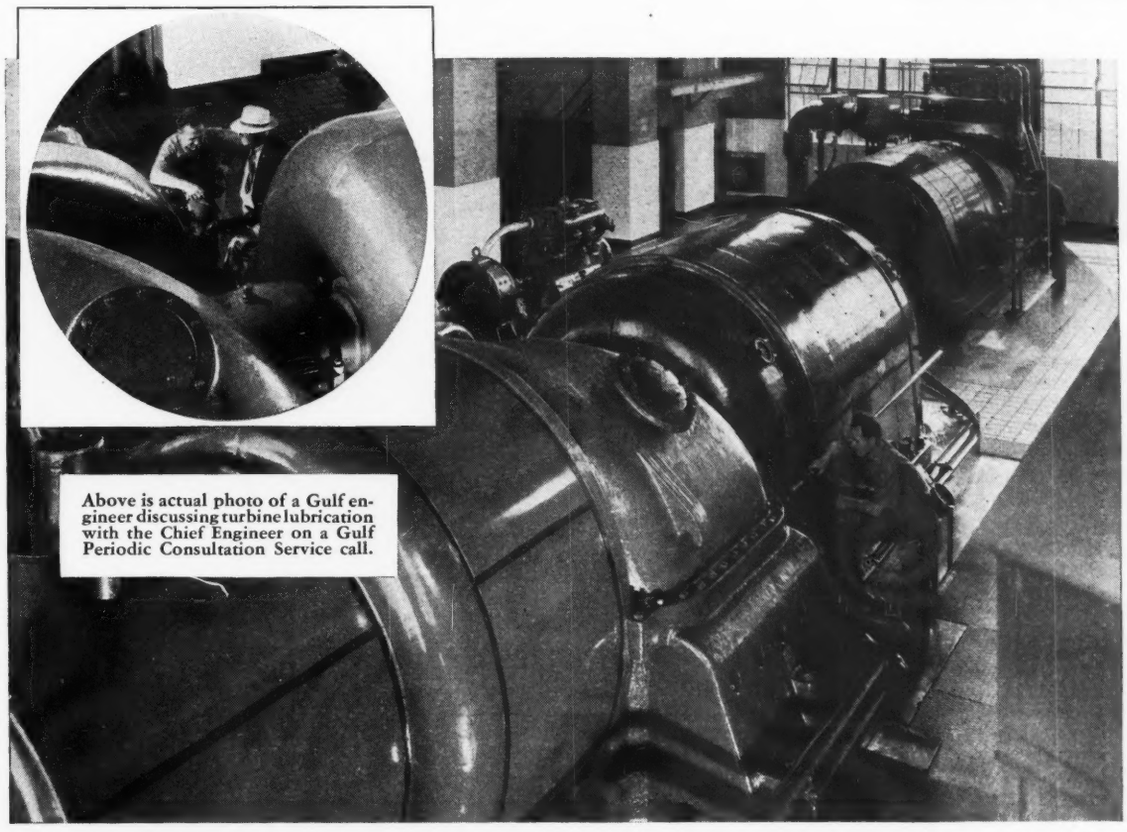
W H Aubrey, vice president, Frick Co, and sales manager of Ice & Refrigerating Machinery Dept, was elected to the board of directors May 28. He is a graduate of Georgia School of Technology, has been with the Frick Co about 23 years, and has been sales manager since 1932.

Hugh R Lambeth has been appointed manager of the Cooling Tower Div, Fluor Corp, Ltd. Mr Lambeth came to the company from the Southern California Gas Co, where he was engaged in industrial engineering. His new duties will include responsibility for cooling tower design, manufacturing and sales.

S W Gibb has been promoted to position of general sales manager, Philadelphia Div, Yale & Towne Mfg Co. He succeeds James C Morgan, who advanced to post of general manager of all Philadelphia operations. Mr Gibb joined the company in 1920 as district sales manager, and for the next several years operated from the Pittsburgh headquarters. In 1929 he was promoted to Pacific Coast sales manager, with headquarters in California. In 1931 he was appointed assistant sales manager for entire Materials-Handling Division.

"GULFCREST OIL *is making a fine record"*

...says Chief Engineer



Above is actual photo of a Gulf engineer discussing turbine lubrication with the Chief Engineer on a Gulf Periodic Consultation Service call.

"and GULF PERIODIC CONSULTATION SERVICE helps us maintain proper Lubrication Practice"

● "We see practically no evidence of deterioration in this remarkable oil—Gulfcrest is the finest turbine lubricant we have ever used," says this Chief Engineer.

Power plant men all over the country know Gulfcrest Oil as the most stable turbine lubricant they have ever used. And for good reason: *Gulfcrest Oil is especially refined and purified by the Alchlor Process,* the most effective method yet developed for removing undesirable hydrocarbons and other impurities which cause oxidation and sludge formation. Gulfcrest Oil has greater resistance to deteriorating influences and, therefore, longer life in service.

Ask the Gulf engineer to give you the complete story about Gulfcrest Oil, and what it can do for you—ask him to explain how Gulf Periodic Consultation Service will help you maintain greater lubricating efficiency. You will not be obligated in any way.

GULF INDUSTRIAL LUBRICATION

This booklet will suggest to you a practical method by which you can increase lubrication efficiency. Write for your free copy.

Gulf Oil Corporation - Gulf Refining Company
3813 Gulf Building, Pittsburgh, Pa. P.

Please send me my copy—no charge—of the booklet "GULF PERIODIC CONSULTATION SERVICE"

Name.....

Company.....

Address.....

PERFECT PORTABILITY

"The Entirely Different Boiler and Engine Treatment"

Sand-Banum goes to the job, does the job on the job, without need of water analyses or interruptions to work in progress; no shut-downs.

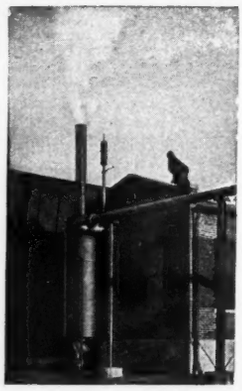
The 16 oz. ready to use handy can contains that pure colloidal concentrate which

Scientifically Removes and Prevents BOILER AND ENGINE SCALE AND CORROSION

One can protects 250 boiler Hp for 30 days. Ask for details and "Proof Plan".

AMERICAN SAND-BANUM CO., Inc.
9 Rockefeller Plaza
New York City

MAXIM SILENCERS



FOR STEAM SILENCING

If it's a noise problem with either *high* or *low* pressure steam dischargers, consult MAXIM.

Maxim Silencers are also made for internal combustion engine *exhaust* or *intake*, for compressor intakes, blowers, etc.

Write for details.

THE MAXIM SILENCER CO.
92 Homestead Ave. Hartford, Conn.

ALL THE HORSE POWER GOES THROUGH THE COUPLING

Ajax graphite-bronze rubber bushed flexible couplings give positive drive . . . protection against misalignment . . . free end float . . . no noise, no backlash . . . no lubrication worries. Write for Catalog.

AJAX
FLEXIBLE COUPLING CO.
Westfield, N. Y.

PAUL N ROBINS has been elected vice-president and treasurer of Greene, Tweed & Co. Mr Robins was formerly with the Manufacturer's Trust Co as assistant vice president, specializing in the industrial field.

A T HOBBS has resigned his appointment as secretary of the Diesel Engine Users Assn, 56 Victoria St, Westminster, London, England.

MR WILLIAM TAGGART has been appointed manager of tube sales of Timken Roller Bearing Co, Canton, Ohio. He has been associated with Steel & Tube Div of the company since June, 1928. Prior to that time he was employed by the Republic Steel Corp.

O P ROBINSON has been appointed to Cutler-Hammer Pittsburgh sales engineering staff. Before joining the Cutler-Hammer Pittsburgh staff Mr Robinson was in the Chicago office.

A I RICHARDSON is now manager of Allis-Chalmers Mfg Co district office at Dallas, Tex. He was formerly with the company's district office at Charlotte, N. C. He entered the employ of Allis-Chalmers in 1925, spending his first two years with the company in their shops.

W L MARTWICK has been elected to position of vice-president of Foster Wheeler Corp, New York, N. Y. Mr Martwick was for some time president of the Aero Pulverizer Co. When this company was absorbed by the Power Specialty Co in 1926, Mr Martwick joined the new company as manager of the Pulverized Fuel Div. Foster Wheeler Corp was formed from Power Specialty Corp and Wheeler Condenser and Engineering Co, at which time he joined the company and progressed through various positions to that of general sales manager.

DR HOWARD A SMITH, until recently research metallurgist with Rustless Iron & Steel Co, Baltimore, Md, and previously in charge of stainless-steel development in laboratories of Republic Steel Co, has been made chief metallurgist of the Duraloy Co, Scottdale, Pa.

FREDERICK G STAMM has been appointed as head of newly-organized Paper Mill Div, Armstrong Machine Works, Three Rivers, Mich. This division was formed to work on the design and construction of equipment for controlling drying on and drainage of paper machines.

STANLEY M MERCIER has been appointed chief engineer of the Conveyor Div, Jeffrey Mfg Co. Mr Mercier will direct all conveyor engineering and engineering sales activities.

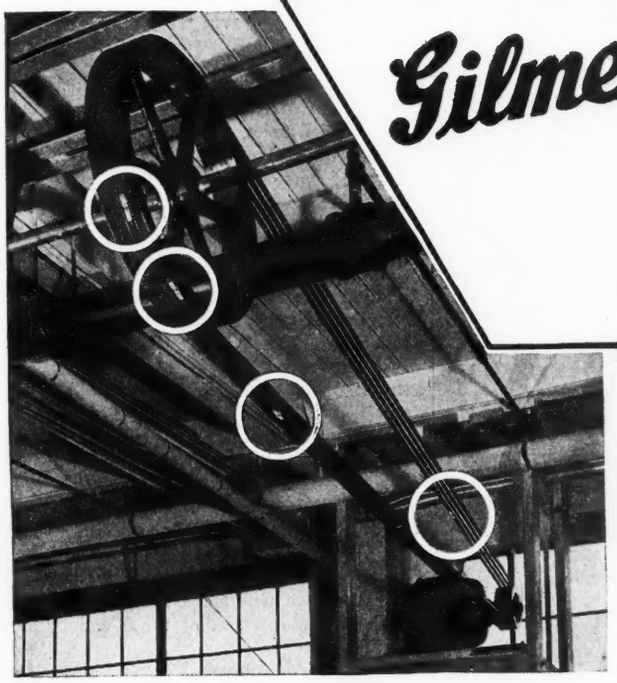
At a recent meeting of New York section, American Association of Textile Chemists and Colorists, EDWARD H SCHMIDT, of Borne Scrymser Co, was elected treasurer. He is chief chemist of the company, with which he has been since 1919.

JOHN G BERGDOLL has been made chief engineer of York Ice Machinery Corp. He was first employed by the corporation

Another contribution to industrial efficiency by

Gilmer STREAMLINER V-BELTING

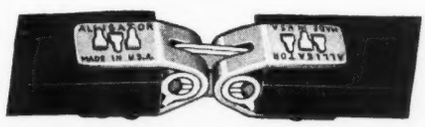
For use where a *connected* type of V-Belt is needed



Gilmer Streamliner V-Belting operating to a lineshaft where an obstruction prevents the use of Endless V-Belts. Connectors shown in circles.

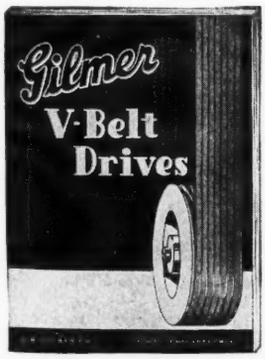
AGAIN Gilmer adds to its record of keeping the wheels of industry turning, more efficiently, more economically, by the perfection of Streamliner, a new type of V-Belting of special construction to be used with a connector. This new Streamliner V-Belting is designed for use on lineshaft and similar drives where an Endless V-Belt is impractical because of physical interferences, where it offers characteristics of effective service heretofore available only in standard Endless V-Belts.

Streamliner V-Belting is made to the same high standards of material and workmanship found in Gilmer Endless V-Belts. Because of its specially-designed construction, Streamliner V-Belting securely grips the flanges of the metal fastener and successfully resists the pull of normal tension under a driving load.



The fastener consists of two die-formed steel end-plates, two 2-piece pins, two bushings, links and special nails. Will withstand excessive wear. Rustproof.

● *Did you get YOUR copy of this FREE engineering handbook?*



The Gilmer Guide to Efficient V-Belt Practise contains new H. P. Rating tables and other engineering information on multiple and fractional horsepower belts and sheaves for both. Write for a copy . . .

it's FREE!

L. H. GILMER COMPANY
TACONY, PHILADELPHIA, PA.
"The Oldest Firm of Rubber Fabric Belt Specialists"

L. H. Gilmer Company,
Tacony, Philadelphia, Pa.

Gentlemen: Send me the following:

☐ Complete information on your new Steamliner V-Belting
☐ A copy of your Gilmer Guide to Efficient V-Belt Practise

NAME_____

ADDRESS_____

FIRM_____

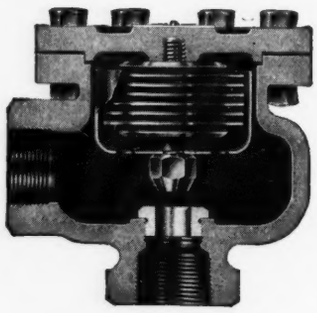
NICHOLSON

CONTROL VALVES FOR LONG, PRESSURE-TIGHT SERVICE

Available in TWO, THREE, FOUR-WAY and Special Types for operating Air, Steam, Water or Oil Cylinders on pressures up to 300 lbs. Made in five different metal combinations to cover all mediums handled. Non-corrosive metals are used in all vital parts. Gaskets and gland packing, suitable for each specific service are used.

Nicholson also offers foot, solenoid and motor operated valves and valves for hydraulic service up to 5000 lbs. pressure. Ask for Bulletin 933 describing "Nicholson" Control Valves.

STURDY STEAM TRAPS WITH EXTRA CAPACITY

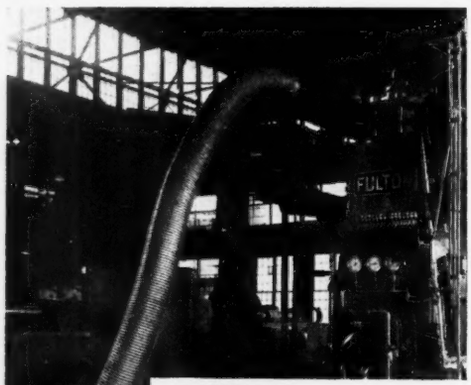


Available in Bronze, Cast Iron and Cast Steel Construction—in sizes from ¼" to 2" and for pressures from vacuum to 300 lbs. with superheat.

Nicholson Industrial Steam Traps are large in capacity, will not freeze, eliminate air binding, require no adjustment, prevent dribbling, provide intermittent discharge and never water-log. In many cases they step up process production from 20 to 30%. Used in leading industrial plants. Ask for Industrial Trap Bulletin No. 439 describing these moderately priced traps.

OTHER NICHOLSON PRODUCTS—NICHOLSON Welded Floats, Piston and Weight Operated Traps, Flexible Couplings, Expanding Mandrels, Arbor Presses, Compression Shaft Couplings, Steam Eliminators and Separators, Compressed Air Traps.

W. H. NICHOLSON & COMPANY
125 OREGON ST. WILKES-BARRE, PENNSYLVANIA, U. S. A.



Sizes 1" to 14"

Plain and Air Jacketed

Do *your* Exhaust Pipes have this PENFLEX *Flexibility?*

On the test block, diesels like this huge Fulton show what they really can do when the exhaust run is perfect. On the job, the same efficient sweeping curves are to be had with ease . . . using PENFLEX, the all-metal tubing with ⅜" of "come and go" for every foot of length. Furthermore, all strains and vibration are stopped at source. Try PENFLEX!

Send for Bul. 70

Pennsylvania Flexible Metallic Tubing Co.
7202 Powers Lane, Philadelphia, Pa.

in 1914 in connection with the York high school cooperative course, and since then has occupied the positions of draftsman, equipment development engineer, product engineer, and assistant chief engineer.

FRED L LAWRENCE has been appointed Detroit district manager of Copperweld Steel Co, Warren, Ohio. His office will be in the General Motors Bldg, Detroit. Mr Lawrence has been connected with the Frost Gear and Forge Co, and Pittsburgh Crucible Steel Co in various capacities.

J T NICHOLSON has recently been appointed junior engineer for Southeastern states of National Aluminate Corp. For the present his headquarters will be in Winston-Salem, N. C. He will work under the direction of W O Widener.

Appointment of HAROLD S WHITING as assistant to chief engineer of Compressor Div of Worthington Pump & Machinery Corp has been announced. He was formerly with Skinner Engine Co, Erie, Pa., for 15 years, and was also identified with Phoenix Ice Machine Co, and Erie Mfg Co, Erie, Pa. He will make his headquarters at the Buffalo Works of the Worthington Corp.

GEORGE K SAURWEIN, superintendent of engineering, Harvard University, Cambridge, Mass., has been elected chairman of the Boston section of the American Society of Mechanical Engineers.

BROOKS FAXON, for the past 36 years New England manager of the Wagner Electric Corp, with headquarters at Boston, has retired. He has been succeeded by Howard W Petty, lately manager for the company in the Buffalo area.

MAX F BECKER, formerly sales manager of the Industrial Div, Whiting Corp, has been appointed vice-president in charge of sales representatives. Mr Becker joined the company in 1920, following his graduation from Purdue University, and has held various other positions in the company ever since.

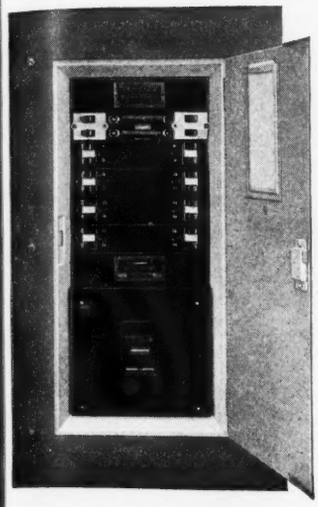
ELMER L LINDSETH, technical assistant to the president, Cleveland Electric Illuminating Co, and a graduate of the Case School of Applied Science, was named president of the Case Alumni Association. Mr Lindseth is the youngest ever nominated for the office, being 38 years of age. He has been with Cleveland Electric Illuminating Co since 1926 and has been engaged in the various technical departments of the company.

BUSINESS ITEMS

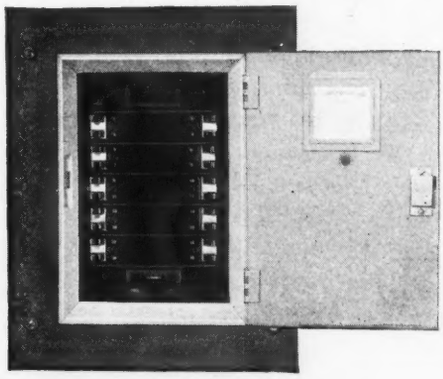
BORDEN METAL PRODUCTS Co has been formed to manufacture gratings, safety steps, spiral stairs, and special floors for industrial plants. Company is headed by A F Borden, and has its offices near Elizabeth, N. J.

General sales office of READING-PRATT & CADY DIV, of American Chain & Cable Co, Inc, formerly located at Bridgeport, Conn.,

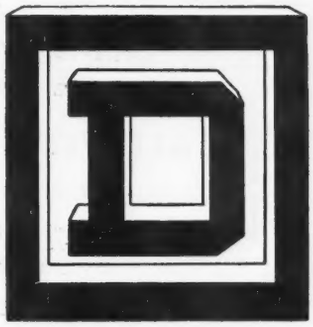
A SQUARE D PANEL BOARD FOR EVERY TYPE OF INDUSTRIAL OR COMMERCIAL BUILDING

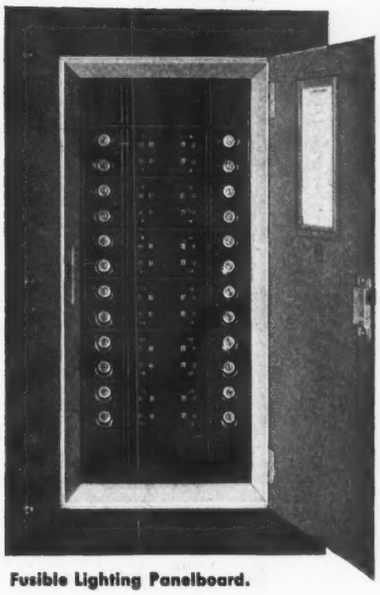


Multi-breakeR Lighting Panelboard with main circuit breaker.

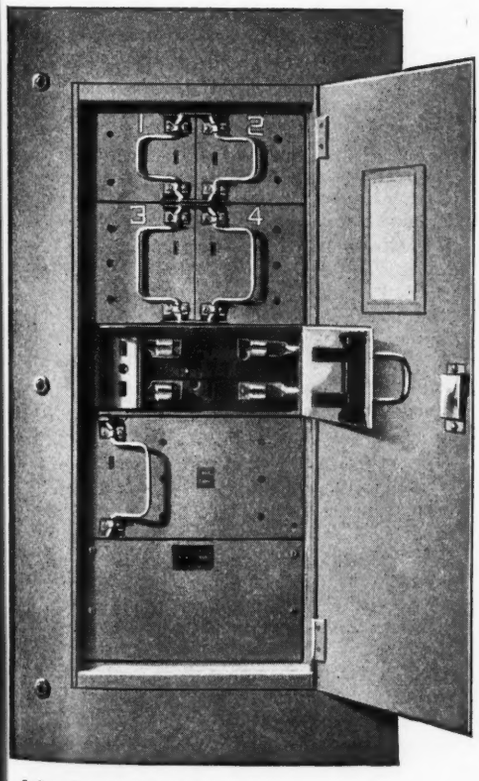


Multi-breakeR Panelboard for lighting and appliances.





Fusible Lighting Panelboard.

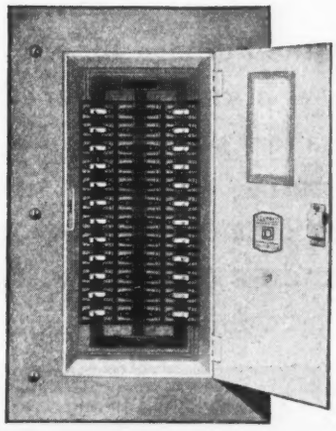


Saflex Convertible Distribution Panelboard for power or lighting.

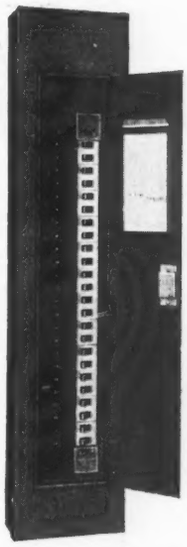
Adequate power and lighting distribution is essential to the modern industrial plant or commercial building. The Square D line of panelboards is complete. It meets every requirement.

Fusible or circuit breaker panelboards; narrow type panels for mounting in I-beams or on columns; the new Multi-breakeR panelboards which provide branch circuit switching and circuit breaker protection at a new low cost.

Square D electrical equipment is available through electrical wholesalers everywhere.



Circuit-breaker Panelboard Type L, quick make, quick break, double break branches.



Multi-breakeR Panelboard Narrow Column Type LX.

CALL IN A

SQUARE D COMPANY

DETROIT - MILWAUKEE - LOS ANGELES

IN CANADA: SQUARE D COMPANY CANADA LIMITED, TORONTO, ONTARIO

SQUARE D MAN

YOUR No. 1 OPPORTUNITY

With industry speeding up to cope with plans for national defense, it is time to step up the efficiency of your power producing equipment to its maximum. That is a job for the most effective INSULATION available. Nominated for that job is the ideal maintenance insulation—

BH No. 1 Insulating Cement

A plastics material easily applied to large and small equipment of odd and irregular shapes. EFFECTIVE UP TO 1800° F . . . 100% reclaimable up to 1200° F . . . Exceptionally high coverage . . . Low volume shrinkage . . . Packed in 50 lb. bags, it presents no storage or breakage problems.

Write for Complete Information to

BALDWIN-HILL CO.

575 Klagg Ave. Trenton, N. J.

ONLY AS GOOD as the JOB it Does!

That's Lubrication—

and you'll never know its real *value* 'till your machinery *proves* it! ★ Made-for-the-Purpose LUBRICANTS keynote a *sixty-six* year Quality demonstration of our Brands of . . .

LUBRICATION

TURBINE OILS **COMPRESSOR OILS**
CYLINDER OILS **DYNAMO OILS**
DIESEL ENGINE OILS **MOTOR OILS**
GREASES . . . *for every requirement.*

BORNE SCRYMSER COMPANY
ESTABLISHED 1874
17 BATTERY PLACE • NEW YORK

has been moved to Reading, Pa.

Name of DE LA VERGNE ENGINE CO has been changed to Baldwin De La Vergne Sales Corp. Change is in name only, and will not affect management, personnel or operation of company.

UNIVERSAL GEAR CORP announces several appointments. J Y Dahlstrand has been made director of sales and engineering. He was chief engineer of the corp for the past two years, and prior to that time was associated with Murray Iron Works Co, Kerr Turbine Co, Westinghouse Electric & Mfg Co, and Allis-Chalmers Mfg Co. M E Robbins, of New York district sales office, has been appointed assistant director of sales in charge of all eastern sales districts. L G Barnes, of the Chicago district sales office, is now manager of the Chicago office and in direct supervision of all sales offices in Illinois and Iowa.

ELASTIC STOP NUT CORP announces moving of general offices from Elizabeth, N. J. to new plant at 2332 Vauxhall Rd, Union, N. J. Houston, Texas, office has been moved to Merchants & Manufacturers Bldg.

GEORGE SCHERR CO, INC, New York, N. Y. announces its appointment as national distributors for complete line of Reed micrometers, made by Reed Small Tool Works, Worcester, Mass.

James C Mallard of Waterville, Me., was elected president of the NEW ENGLAND STATES ASSOCIATION OF POWER ENGINEERS at the annual convention in Boston on June 14. Ferrand H Van Dyck, of Worcester, Mass., was made vice-president. Arthur A Austin and Walter H Damon of Springfield, Mass., were elected secretary and treasurer, respectively.

Minneapolis office and warehouse of CUTLER-HAMMER, INC, has been moved to larger quarters at 532 South Seventh St. J U Heuser is district sales manager.

TIMBER ENGINEERING CO of New England has been formed, with offices at 422 Border St, East Boston, Mass. New company will operate throughout northeastern states supplying information on use of timber as engineering material.

PAINT ENGINEERS, INC, Hawthorne, N. J., is a new corporation which will act not only as paint manufacturers, but as consultants in preparation of paint specifications and paint systems. Robert E Mitchell, president of new company, was formerly with Joseph Dixon Crucible Co, and prior to that, with Valentine & Co.

LINDE AIR PRODUCTS CO, New York, has announced election of T D Cartledge and L A Bliss as vice-presidents, and E J Hayden as vice-president, central division. E B Suydam, formerly assistant general sales manager, has been made general sales manager, succeeding Mr Cartledge, and P B Pew, formerly assistant works manager, has been appointed works manager to succeed Mr Bliss.

C K BRYCE has been elected vice-presi-

BASICALLY DIFFERENT LUBRICATING OILS REMOVE HARD CARBON;

have 3 to 10 TIMES STRONGER FILM

LION **Naturalube** MOTOR OIL
DIESEL AND HEAVY DUTY OIL*

Consider the two outstanding lubricating properties of Lion Naturalube—the ability to gradually remove hard carbon deposits from pistons, rings and valves and its three to ten times stronger film. It is then evident that Naturalube is better fitted to conserve power and reduce wear than are conventional type oils.

That Naturalube keeps engines cleaner and lubricates better is not just a theory but a fact. The results of hundreds of tests prove that Naturalube's unusual solvent and penetrative properties gradually remove hard carbon—that Naturalube's three to ten times stronger film is the highest type protection against friction-wear. Also, hundreds of service records prove that Naturalube adds horsepower, saves fuel, saves wear and reduces shut-down time.

***** ***Naturalube Diesel and heavy duty oil is specially fortified or reinforced to resist the effects of intensified heat and oxidation under extreme conditions. Engines constantly operated at high speeds and/or heavy loads need this super lubrication.***

For visible proof of Naturalube's money-saving properties and details of money-back guarantee phone the nearest Lion Naturalube dealer or write Lion Oil Refining Company, El Dorado, Arkansas.

LION OIL REFINING COMPANY
EL DORADO ARKANSAS

LION PETROLEUM PRODUCTS

LION Naturalube KEEPS MOTORS CLEANER, LUBRICATES BETTER

COTTRELL PROCESS OF ELECTRICAL PRECIPITATION

universally recognized as a standard method of removing

DUST, FLY ASH, FUME, MIST & FOG *from* GASES

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28 years of research development and operating experience by the affiliated Cottrell Companies throughout the world is incorporated in the

COTTRELL INSTALLATIONS

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405 LEXINGTON AVENUE, NEW YORK CITY — 59 EAST VAN BUREN STREET, CHICAGO, ILL.

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WESTERN PRECIPITATION CORP.

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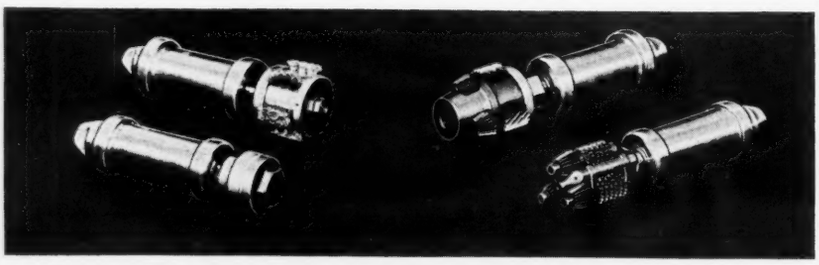


A group of Wilson ST Series Air or Steam Motors with Wilson Expanding Brush, Cutter Heads and Vibrator.

PROVEN SUPERIORITY

In both laboratory tests and in actual use Wilson Air, Steam, Water or Electrically driven tube cleaners have proven their superiority over and over again.

Simplicity of design—rugged construction—the highest quality materials and skilled workmanship assure the high power, easy and economical operation and long life of every Wilson Cleaner.

No matter whether you have to clean straight or curved tubes or pipes—of small or large diameter—you will find a Wilson Cleaner especially suitable for your purpose.

Send for the name of our representative nearest to you or for a copy of our new thirty-six page catalog fully describing and illustrating the complete line of Wilson tube cleaning equipment.

THOMAS C. WILSON, Inc.

PIPE AND TUBE CLEANERS EXCLUSIVELY

47-28 37th Street — Long Island City, N. Y.

dent of Oxweld Acetylene Co, New York. Mr Bryce was formerly manager of factories in the company.

AMERICAN ENGINEERING Co, Philadelphia, Pa., announces following appointments: J S Bennett as manager of sales and William H Schultze as sales manager, Marine Div. C L Myers will continue as sales manager of Stoker Div.

Houston office of CHICAGO BRIDGE & IRON Co will be moved from 2219 Main St to 918 Richmond Ave. Personnel of this office will be augmented by transfer of S C Hamilton from Birmingham to Houston and by opening of new erection office to handle field work in the Southwest. W T HUDSON will be in charge of erection office and will be assisted by Dan O'Laurie.

THE BLAST COIL MANUFACTURERS' INSTITUTE was formed May 11 in Detroit, after a meeting of engineers from many of the blast surface manufacturers. The officers of the new association are R J Resch, McQuay, Inc, president; R M Stikeleather, B F Sturtevant Co, vice-president; M F May, Young Radiator Co, secy-treas. Purpose of group is to develop and establish standard method of testing and rating blast coils for heating and cooling equipment.

WICKWIRE SPENCER STEEL Co, 500 Fifth Ave, New York, N. Y., announces several changes in personnel. G L Crawford has been made Buffalo district manager in charge of sales of all products, replacing A G Bussmann, who was recently promoted to general sales manager. A S Rairden was appointed wire rope sales manager. He was formerly with the American Cable Co and Hazard Wire Rope Co. E C Stout has returned to continue his work as manager of eastern district. His office is at the general offices of the company in New York.

AMERICAN SOCIETY FOR MEASUREMENT AND CONTROL announce officers for coming year, following a meeting held recently. They are R J S Pigott, Gulf Research and Development Co, president; M F Behar, editor, *Instruments*, vice-president; Frank C McGough, Weirton Steel Co, secretary; Clarke H Fry, Westinghouse Electric & Mfg Co, treasurer; K D Johnson. Caterpillar Tractor Co. director; and J B Neller, Carnegie-Illinois Steel Corp, director.

COOPER-BESSEMER CORP has recently announced appointment of John Rogers as sales engineer, with headquarters on the Pacific Coast. J W Reed has been transferred from Los Angeles to New York office and has been appointed Atlantic Coast manager of Gas Engine and Compressor Div.

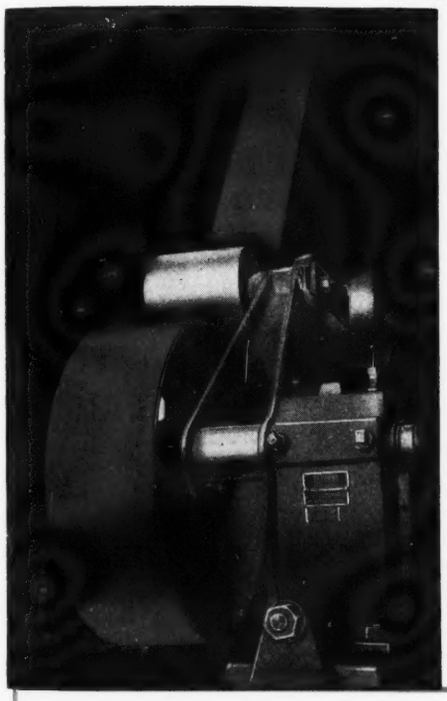
TERRY STEAM TURBINE Co announces appointment of Northwestern Power Equipment Co, St. Paul, Minn., as sales representatives of the company.

DIAMOND POWER SPECIALTY CORP has appointed G C Kahl as representative in Kansas City, Mo. Mr Kahl's office will be in the Dwight Bldg. He replaces L S Osborn, who died recently.

Condor Compensated Belt . .

PATENTED

TRADE MARK REGISTERED



The Belt With Equalized Ply Stresses

Outearns Its Cost Twelve* Ways

EACH of the twelve* advantages listed below is a money saver important enough to justify your putting a Condor Compensated Belt to work for you.

If you keep a belting ledger, your first installation will be the beginning of new and gratifying money-saving adventure in your plant.

Read over these twelve* advantages and then follow through by writing for Bulletin 6808-C which illustrates and explains them more fully.

Condor PRODUCTS

- Conveyor and Elevator Belt
- Transmission Belt
- V-Belt
- Air Hose
- Contractors Hose
- Fire Hose
- Hydraulic Hose
- Oil and Gasoline Hose
- Sand Blast Hose
- Steam Hose
- Suction Hose
- Water Hose
- Chute Lining
- Launder Lining
- Industrial Brake Blocks and Lining
- Molded Rubber Goods
- Rubber Lined Tanks
- Rubber Covered Rolls
- Abrasive Wheels
- Bowling Balls

*12 ADVANTAGES

1. Ruptures in outside ply eliminated.
2. Freedom from ply separation.
3. Longer fastener life.
4. Can be operated on smaller pulleys.
5. Less bearing, shafting and hanger troubles.
6. For heavy loads, plies may be increased with same pulleys.
7. Operation less affected by atmospheric conditions.
8. Higher overload capacity or margin of safety.
9. Less wear on pulley side.
10. Can be dressed without injury to belt.
11. High production efficiency.
12. Material reduction in belting costs.

THE MANHATTAN RUBBER MFG. DIVISION

OF RAYBESTOS-MANHATTAN, INC.

EXECUTIVE OFFICES AND FACTORIES

31 Townsend St., Passaic, N. J.

INDUSTRIAL WASTE TREATMENT MADE EASY WITH FERRISUL

The problem of treating industrial wastes becomes easy when Ferrisul (anhydrous ferric sulfate) is used as a coagulant. It is effective at all temperatures, and in either alkaline or acid waters.

Most plants treating industrial wastes require brief settling time, and, since Ferrisul provides a quick-forming, rapid-settling floc at all times, it can be used under conditions where other coagulants might fail.

Ferrisul is easy to handle and economical to store, with no melting in summer or freezing in winter, and requires a minimum of control in operation. Write for your copy of the *new* Ferrisul booklet, giving complete information on treatment of water, sewage and industrial wastes. MONSANTO CHEMICAL COMPANY, Merrimac Division, Everett Station, Boston, Massachusetts.

FERRISUL
For treatment of
Sewage and Industrial Waste

MONSANTO
CHEMICALS
SERVING INDUSTRY . . . WHICH SERVES MANKIND

At a meeting of HARBISON-WALKER REFRACTORIES CO, board of directors, W B Coullie, formerly assistant to the president, and general sales manager, was elected a vice-president. H S Robertson, formerly an assistant general sales manager, has been made general sales manager.

PACIFIC PUMP WORKS announces that Mid-Continent Pump Supply Co of Tulsa, Okla., has taken over distribution, sales and service for the company. Operations in the area will be under the direction of Roy A Dunbar, president of the Mid-Continent Co.

CHLORAMINE CO announces opening of its Bacteriological Research Laboratories, 101 Park Ave, New York, N. Y., in which it will conduct tests concerning water treatment and other related subjects.

STEWART E LAUER, president of the York Ice Machinery Corp, was elected president of the Air Conditioning Manufacturers' Association, May 11. Other officers elected were Stuart M Crocker, General Electric Co, vice-president; and P A McKittrick, Parks-Cramer Co, treasurer.

HARBISON-WALKER REFRACTORIES CO announces purchase of Athens plant, Athens Brick & Tile Co, Athens, Texas. Purchase covers all plant equipment, inventories, etc, and plant is now operated as a unit of Harbison-Walker Co.

JOHN RAMMING MACHINE CO is now located in new plant at 4591 McRee Ave, St. Louis, Mo.

POMONA PUMP CO announces election of C L Barrett, formerly general sales manager, to position of vice-president in charge of sales, and appointment of W D Turnbull as general sales manager in charge of New York office. Executive eastern office has been opened at 120 Broadway, N. Y.

AIR REDUCTION SALES CO announces changes in personnel. E H Anchors formerly branch manager, has been made manager of the Oklahoma district. C R Hale has been appointed purchasing agent for the company. He has been purchasing agent since 1936. Mr Hale succeeds H M Daggett, who has retired.

In honor of its 75th anniversary, gold service emblems have been presented to employees of E F HOUGHTON & Co, Philadelphia, Pa. A total of 324 men and 77 women were given these emblems by A E Carpenter, president. Of these, 110 men and 39 women have been employed from 10 to 20 years, 30 men and 15 women from 20 to 30 years, and six men for more than 30 years.

AMERICAN CHAIN & CABLE CO, Bridgeport, Conn., announces merger of company with organization of Julian d'Este Co, effective May 31, 1940. d'Este products will be manufactured in plants at Reading, Pa. Company will retain name of American Chain & Cable Co.

"STANDCO" PILLOW BLOCKS

Fig. 1635

Combining clamp block and pillow block requirements in one type, the "Standco" shown above is sturdily built and is offered in a wide range of sizes. Babbitted bearing surfaces are finished beautifully smooth. It can be depended on for long, trouble-free service.

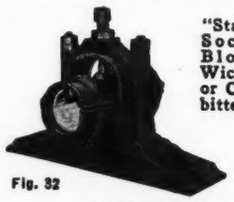


Fig. 32

"Standco" Ball and Socket Pillow Block, Ring or Wick Oiling, Plain or Collar End Babbitted Bearings.

Write for Bulletin

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA.

Boston, Detroit, Indianapolis — Box 577 — Chicago, St. Louis, San Francisco

ESPECIALLY DESIGNED FOR LOW PRESSURE BOILERS AND CONVERTED HIGH PRESSURE BOILERS

★ Model "GLP" ★

Model "GLP", A.S.M.E., Iron Body, Bronze mounted. A.S.M.E. standard, saturated steam pressure 30 max. lbs.

Has a high lift and exceedingly high relieving capacity.

Can be set to blow off at 10, 15, 20, 25 or 30 lbs. *Sizes:* 2½", 3", 3½", 4", 4½"

Lonergan
A COMPLETE LINE OF **Valves**
• GAUGES • SPECIALTIES

For complete catalog of LONERGAN Valves, Gauges and Steam Specialties write J. E. LONERGAN COMPANY, Race & Second Sts., Philadelphia, Pa.

300 SPECIALTIES FOR POWER PLANTS—SINCE 1872